SPACE SHUTTLE

Solid Rocket Motor
Thiokol Corporation

TWR-60695
Revision B

Final Postflight Hardware Evaluation Report 360T021(RSRM-21, STS-45)

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Thiokol CORPORATION
SPACE OPERATIONS

Final Postflight Hardware Evaluation Report 360T021 (RSRM-21, STS-45)

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List of Acronyms

Acronym	Definition
B–B	Barrier-Booster
CCP	Carbon Cloth Phenolic
CEI	Contract End Item
CF EPDM	Carbon Fiber-Filled Ethylene Propylene Diene Monomer
CPT	Component Program Team
DR	Discrepancy Report
ET	External Tank
GCP	Glass Cloth Phenolic
ID	Inside Diameter
IFA	In-Flight Anomaly
KSC	Kennedy Space Center
LDI	Low Density Indication
LH	Left Hand
MRB	Material Review Board
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
OD	Outside Diameter
PEEP	Postflight Engineering Evaluation Plan
PFAR	Postfire Anomaly Record
PFOR	Postfire Observation Record
PR	Problem Report (KSC)
RH	Right Hand
RSRM	Redesigned Solid Rocket Motor
RTV	Room Temperature Vulcanized (Rubber)
S&A	Safe and Arm Device
SCP	Silica Cloth Phenolic

List of Acronyms (Cont.)

Acronym	Definition
SII	SRM Ignition Initiator
STS	Space Transportation System
TWR	Thiokol Wasatch Report

Definitions

ACTUAL SAFETY FACTOR

A postfire safety factor based on material decomposition depth and the actual prefire insulation thickness measurements:

$$ASF = \frac{\text{actual prefire insulation thickness measurement}}{\text{material decomposition depth}}$$

ADHESIVE/COHESIVE FAILURE

Adhesive	Failure at the interface of two materials leaving a relatively smooth surface on the exposed material.
Cohesive	Failure within a parent material leaving a jagged/rough surface on the exposed material.

BLOW-BY

Hot gas past a seal as evidenced by visual soot deposition.

BLOWHOLE/GAS PATH

Terminated	Gas penetration terminating within the RTV. Typically evidenced by soot.
Through	Gas penetration completely through the RTV. Typically evidenced by soot.

CHAR

The substance remaining after the resin in the virgin material has been extracted by hot gases.

COMPLIANCE THERMAL (Material Decomposition) SAFETY FACTOR

A postfire safety factor based on material decomposition depth and the prefire minimum 1U drawing thickness:

$$CSF = \frac{\text{material prefire minimum 1U drawing thickness}}{\text{material decomposition depth}}$$

Definitions (Cont.)

CORROSION

Light	Can be wiped off with a dry rag. A stain may remain that cannot be felt with a 5-mil brass shim stock.
Medium	After wiping with a dry rag, corrosion can be felt with a 5-mil brass shim stock.
Heavy	After corrosion is removed, resultant pitting is present.

DELAMINATION

Failure within nozzle phenolic occurring between plies. Typically does not result in missing material.

EROSION (CCP)

Dimple	A continuous pattern of shallow erosion with an axial length greater than the circumferential width. Typically occurs on the forward exit cone aft end.
Pocketing	Erosion with a steep edge at the forward edge of the anomaly. Pocketing typically occurs at the bondline interface.
Ripple	A continuous pattern of shallow wavy erosion. Typically occurs on the throat ring.
Washing	Localized shallow erosion without steep edges.

FIELD JOINT ADHESIVE BONDLINE

The region of the tang and clevis insulation contact where the pressure sensitive adhesive is applied (from the tip of the J-leg outboard 1.5-to-2.0 inches). This definition is not the same as the CEI definition of a bondline.

INTERNAL INSULATION

Asymmetric Erosion	An appearance of abnormal erosion on the forward or aft ramp area of the factory joint insulation where the ramp is eroded in a localized region further axially than the surrounding areas. It is most apparent at ply overlaps.
Char Layer	Charred insulation and particulate slag.
Crazing	Crack in the insulation with no measurable depth. Usually seen on clevis insulation.

Definitions (Cont.)

Gas Path	Localized severely eroded region into the insulation.
Heat Affected Layer	Insulation color ranges from tan to orange to dark brown.
Insulation Flashing	Thin membrane of insulation (less than 0.020 inch thick) located at the edge of the insulation surface. Insulation flashing may or may not be securely bonded.
Ply Separation	A non-adhesion between insulation plies.
Pocketing/Gouging	Localized recess in the insulation pattern.
Unbond	Bondline failure between the Chemlok® and the case or between the Chemlok® and the insulation.
Virgin Layer	Insulation color ranges from light green to all shades of olive green. Polysulfide color ranges from orange to tan to brown.

MATERIAL DECOMPOSITION DEPTH (MDD)

The depth of material that is eroded, charred, or heat affected.

MDD = Prefire Insulation Thickness – Postfire Insulation Thickness

NOZZLE-TO-CASE JOINT BONDLINE

The polysulfide adhesive region of the aft dome and fixed housing insulation joint contact extending from the forward edge of the joint to the wiper O-ring. This definition is not the same as the CEI definition of a bondline.

Porosity	Region in the nozzle-to-case joint polysulfide adhesive which contains small bubbles. Porosity is normally observed in the step region of the joint and in the heat affected region at the forward end of the bondline.

PLY LIFTING

The separation of several adjacent charred CCP plies creating subsurface voids. This condition usually occurs near the char line well away from the flow surface, but may occur near the flow surface and become exposed by wedgeouts or popped plies during cool-down. Typically occurs on the cowl ring and aft exit cone.

PLY WRINKLING

Deviation of phenolic plies during the cure process resulting in a wavy ply configuration.

Definitions (Cont.)

POLYSULFIDE

Heat Affected	Polysulfide is dark or black in color with a glossy appearance.
Unaffected (Virgin)	Polysulfide ranges in color from orange to tan to brown.

POPPED PLY

Displaced CCP material that is parallel to the ply angle of the nozzle component. Occurs during cool-down.

POSTFIRE INSULATION THICKNESS (VIRGIN INSULATION)

Postfire insulation thickness measured after char rinse.

SEAL DEFECT/DAMAGE

Cut	Width, essentially zero (have to open up to find the damage) and depth greater than 0.005 inch.
Scratch	Width 0.005 inch or less and depth 0.005 inch or less.
Nick	Width less than 0.020 inch, but greater than 0.005 inch; and depth less than 0.010 inch, but greater than 0.005 inch.
Flowline	Visible evidence of incomplete flow or knit of the elastomer material (circumferential or radial).
(i) Closed:	Tightly adhered, not separable, does not open when lightly probed.
(ii) Separable:	Visually appears closed. Separates when lightly probed.
(iii) Open:	Obvious separation or gap.
Hard Inclusions	Foreign material enclosed in the seal material.
Porosity/Soft Inclusion	A pocket of air or constituent material enclosed in the seal material.
Extrusion Damage	Seal material pinched and/or cut due to extrusion under pressure or an overfill condition.
Heat Effect	Glossy and/or hardened surface due to hot gas impingement.
Erosion	Seal material missing due to hot gas impingement or blow-by.

Definitions (Cont.)

SPOTTY LINER

Uniform liner coverage identified between approximately 10 and 75 percent of a region.

THERMAL PROTECTION REQUIREMENT

Postflight insulation thickness which is requured to:

a. Ensure the case segment insulation-to-case bondline temperature does not exceed 200 degrees Fahrenheit.

b. Ensure the insulation-to-case bondlines at the case field joints, factory joints and nozzle-to-case joints do not exceed 200 degrees Fahrenheit.

c. Ensure the igniter chamber internal and external insulation-to-case bondlines do not exceed 500 degrees Fahrenheit.

d. Ensure the insulation-to-case bondlines at the igniter adapter-to-igniter chamber and igniter-to-case joints do not exceed 200 degrees Fahrenheit.

VOID

Phenolic Bondline	Areas of no adhesive. May be encapsulated or at edge of bondline.
RTV	Encapsulated areas of no RTV. Does not include scalloped areas on forward or aft edges of RTV fill.

WEDGEOUT

Missing CCP material that is parallel to the ply angle of the nozzle component. Occurs during cool-down.

WET SOOTING

Sooting identified within the case field joint adhesive bondline at the ID tip of the J-leg. Soot is deposited on the surface of the insulation during joint flexing at splashdown. Wet sooting is easily removed with a solvent, leaving a clean insulation surface with no heat effects.

1.0 INTRODUCTION

This document is the final report for the Clearfield disassembly evaluation and a continuation of KSC postflight assessment for the 360T021 (STS-45) RSRM flight set. All observed hardware conditions were documented on PFORs and are included in Appendices A through E. This report, along with the KSC Ten-Day Postflight Hardware Evaluation Report (TWR-61502), represents a summary of the 360T021 hardware evaluation. The configuration evaluated is documented in TWR-60467. Disassembly evaluation photograph numbers are logged in TWA-1982.

The RSRM 360T021 flight set disassembly evaluations described in this document were performed at the RSRM Refurbishment Facility in Clearfield, Utah. Figure 1 details the RSRM case nomenclature used in this document. The case segments and nozzles were shipped from KSC Hangar AF and disassembled at the RSRM Refurbishment Facility in Clearfield, Utah. The final factory joint demate occurred on 02 October 1992.

Detailed evaluations were performed in accordance with the Clearfield PEEP, TWR-50051, Revision A. All observations were compared against limits that are also defined in the PEEP. These limits outline the criteria for categorizing the observations as acceptable, reportable, or critical. Hardware conditions that were unexpected and/or determined to be reportable or critical were evaluated by the applicable CPT and tracked through the PFAR system.

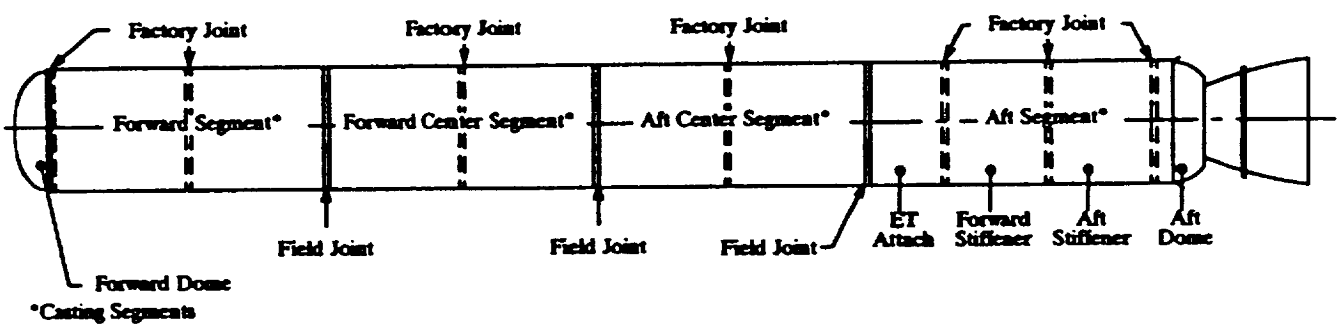


Figure 1. RSRM Case Description

2.0 REFERENCES

The following documents are referenced herein:

CPW1-3600A	Prime Equipment End Item Detail Specification, Part I of Two Parts; Performance, Design, and Verification Requirements, Space Shuttle Redesigned Solid Rocket Motor CPW1-3600 For Space Shuttle Solid Rocket Motor Project, Operational Flight Motors (RSRM-4 and subsequent)
TWA-1982	360T021, STS-45, Clearfield Postflight Photo Log
TWR-50050	KSC Postflight Engineering Evaluation Plan (PEEP)
TWR-50051	Clearfield Postflight Engineering Evaluation Plan (PEEP)
TWR-60467	STS-45, 360T021, KSC Processing Configuration and Data Report
TWR-60635	Postflight Hardware Special Issues for 360T021, STS-45 Clearfield
TWR-61502	360T021 KSC Ten-Day Postflight Hardware Evaluation Report
TWR-60707	RSRM Hardware Assessment at KSC (Presentation of 360T021 PFARs to RPRB)

3.0 EVALUATION SUMMARY

Table 1 provides a summary of all postflight-related Squawks/Preliminary PFARs, PFARs, IFAs and SPRs for 360T021.

Table 1. Summary of 360T021 Activity

	Squawks/Prelim PFARs	PFARs	IFAs	SPRs
KSC	11	7	0	0
Clearfield	16	4	0	0
Total	27	11	0	0

A list of all 360T021 PFARs is included in Table 2. This includes Squawks and Preliminary PFARs that were written and not elevated to PFARs. Information on postflight Squawks and IFAs can be found in TWR-61502.

3.1 CEI Specification Compliance

Based on hardware evaluations at KSC and Clearfield, as defined in the respective PEEPs (TWR-50050, Revision C and TWR-50051, Revision A), all hardware met the CEI specification requirements of CPW1-3600A.

Table 2. PFAR Summary For 360T021

PFAR/SQUAWK/ PRELIM. PFAR NUMBER	TYPE	ELEVATED FROM	REFERENCE SPR NUMBER	REFERENCE IFA NUMBER	EVALUATION LOCATION	RESPONSIBLE COMPONENT TEAM	SPAT/ RPRB DATE	DESCRIPTION
4S-023	SQUAWK	N/A	N/A	N/A	KSC	SEAL SURF.	04/01/92	SCRATCH ON THE PRIMARY SEAL SURFACE OF 40-DEGREE OPT
4S-025	SQUAWK	N/A	N/A	N/A	KSC	NOZZLE	04/02/92	COWL WEDGEOUT OCCURRING DURING MOTOR OPERATION
4S-033	SQUAWK	N/A	N/A	N/A	KSC	IGNITER	04/07/92	MOLYKOTE ON IGNITER OUTER JOINT PRIMARY AND SECONDARY SEAL CUSHION
4S-034	SQUAWK	N/A	N/A	N/A	KSC	IGNITER	04/07/92	EXCESSIVE FLASHING ON FORWARD AND AFT FACES OF OUTER JOINT ENVIRONMENTAL SEAL
4SC-01	PRELIM.	N/A	N/A	N/A	H-5/H-7	SEAL SURF.	04/08/92	HEAVY CORROSION ON PRIMARY SEAL SURFACE NOZZLE JOINT NO. 4 THROAT HOUSING
4SC-02	PRELIM.	N/A	N/A	N/A	H-5/H-7	SEAL SURF.	04/08/92	HEAVY CORROSION ON PRIMARY SEAL SURFACE JOINT NO. 4 THROAT HOUSING
4SC-03	PRELIM.	N/A	N/A	N/A	H-5/H-7	SEAL SURF.	04/08/92	HEAVY CORROSION ON SECONDARY SEAL SURFACE OF NOZZLE JOINT NO. 4 FORWARD EXIT CONE
4SC-05	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	04/08/92	BROKEN BEARING PROTECTOR BOLTS
4SC-07	PRELIM.	N/A	N/A	N/A	H-5/H-7	PORTS/PLUGS	04/16/92	SCRATCH ON NOZZLE JOINT NO. 3 LEAK TEST PLUG SEALING SURFACE
4SC-08	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	04/10/92	SOOT IN THE COWL BONDLINE
4SC-09	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	04/13/92	ABNORMAL FIXED HOUSING BONDLINE FAILURE MODE
4SC-10	PRELIM.	N/A	N/A	N/A	H-5/H-7	NOZZLE	04/13/92	RESIN GLAZE ON FIXED HOUSING BONDLINE GCP
4SC-12	PRELIM.	N/A	N/A	N/A	H-5/H-7	IGNITER	04/15/92	FOREIGN MATERIAL ON THE B-B ROTOR SHAFT SECONDARY SEALS
4SC-13	PRELIM.	N/A	N/A	N/A	H-5/H-7	IGNITER	04/15/92	FOREIGN MATERIAL IN THE B-B ULLAGE CAVITY AND ON THE ROTOR SHAFT SECONDARY SEALS
4SC-15	PRELIM.	N/A	N/A	N/A	H-5/H-7	INSULATION	08/11/92	INSULATION COMPLIANCE SAFETY FACTOR VIOLATION
4SC-16	PRELIM.	N/A	N/A	N/A	H-5/H-7	INSULATION	08/25/92	INSULATION (ACREAGE AND FACTORY JOINT) COMPLIANCE SAFETY FACTOR VIOLATIONS
360T021A-01	PFAR	4S-000	N/A	N/A	KSC	NOZZLE	04/24/92	EXCESSIVE GREASE IN JOINT 1 LEAK CHECK PORT
360T021A-02	PFAR	4S-022	N/A	N/A	KSC	NOZZLE	04/29/92	FOREIGN MATERIAL ON NOZZLE-TO-CASE JOINT VENT PORT PLUG SECONDARY O-RING
360T021B-03	PFAR	4S-024	N/A	N/A	KSC	SEALS	04/24/92	EXCESSIVE ENVIRONMENTAL SEAL FLASHING ON S&A GASKET AFT FACE
360T021A-04	PFAR	4S-027	N/A	N/A	KSC	JPS/TPS	04/24/92	IGNITER HEATER CABLE ATTACH POINT NOT TO DRAWING SPECS
360T021A-05	PFAR	4S-031	N/A	N/A	KSC	IGNITER	04/24/92	SCRATCH ON IGNITER ADAPTER 180 DEGREE SPECIAL BOLT SPOTFACE
360T021B-06	PFAR	4S-032	N/A	N/A	KSC	INSULATION	04/24/92	FOREIGN MATERIAL ON FORWARD FACE OF THE INSULATION OF THE IGNITER CHAMBER ID
360T021B-07	PFAR	4S-035	N/A	N/A	KSC	CASE	04/24/92	FORWARD FIELD JOINT PRIMARY O-RING DISASSEMBLY DAMAGE
360T021A-08	PFAR	4SC-04	N/A	N/A	H-5/H-7	NOZZLE	04/29/92	FOREIGN MATERIAL (RTV) BETWEEN THE O-RINGS IN JOINT 5
360T021B-09	PFAR	4SC-06	N/A	N/A	H-5/H-7	NOZZLE	04/24/92	FOREIGN MATERIAL ON AND PAST JOINT 2 PRIMARY O-RING
360T021A-10	PFAR	4SC-11	N/A	N/A	H-5/H-7	IGNITER	04/29/92	MEDIUM-TO-HEAVY CORROSION ON THE S&A ROTOR DETENT BALL SPRING
360T021A-11	PFAR	4SC-14	N/A	N/A	H-5/H-7	PORTS/PLUGS	04/29/92	MISSING MATERIAL ON 198 DEGREE SII PLUG THREADS

4.0 COMPONENT EVALUATIONS

The following sections detail, by component, the hardware condition observed at Clearfield.

4.1 Insulation

Internal insulation evaluations of the igniter insulation, case acreage, factory joints and liners are summarized in the following sections. PFORs documenting the observations are found in Appendix A.

4.1.1 Thermal Performance Evaluation

Summaries of the safety factors for the nozzle-to-case, field joint, factory joint, case acreage and igniter insulation are found in Table 3 through Table 7, respectively. All safety factors for these areas can be found in Appendix E, Tables 1 through 22. Note that all joint insulation regions, including factory joints, must meet a minimum safety factor of 2.0. A minimum safety factor of 1.5 is required in the acreage insulation regions. The igniter insulation forward of the igniter nozzle insert (Zone A), requires a minimum remaining insulation thickness of 0.010 inch.

Preliminary PFARs 45C–15 and 45C–16 were written for apparent Compliance Safety Factor violations (see Tables 4 and 5). These violations were attributed to inaccurate measurement data. All other safety factors were within CEI specification limits. All thermal protection requirements were met.

4.1.2 Internal Insulation Samples

The RH forward center factory joint and flap bulb region had insulation samples removed at three degree locations as specified in the Clearfield PEEP. No voids or other anomalies were found in any of the samples.

One additional sample was removed from the LH forward center acreage region per AO 4C6–49. A 25–inch long "ridge" in the insulation was noted at 90 degrees, 85 inches forward of the tang. Dissection of the sample showed that the ridge consisted of a localized build–up of insulation. Thickness in this region measured 0.26 inch compared with a nominal of 0.120 inch. No unbonds or other anomalous conditions resulted from the ridge.

4.1.3 Liner

Detailed liner maps are included in Appendix A. The remaining liner patterns were typical of past flight motors.

Table 3. Summary of 360T021 Nozzle-to-Case Joint and Field Joint Safety Factors

Joint	Min. Compliance Safety Factor (CSF) *	Degree Location	Min. Actual Safety Factor (ASF) *	Degree Location
Nozzle-to-Case, LH	3.7	180.0	4.3	180.0
Nozzle-to-Case, RH	3.8	111.6	4.3	111.6
Aft Field Joint, LH	5.1	106.0, 150.0	5.4	106.0, 150.0
Aft Field Joint, RH	5.2	46.0	5.6	2.0, 46.0
Center Field Joint, LH	9.1	106.0	9.9	106.0
Center Field Joint, RH	10.8	60.0	11.2	60.0
Forward Field Joint, LH	13.2	30.0	14.1	30.0
Forward Field Joint, RH	11.8	46.0	12.7	46.0

* Minimum required joint insulation safety factor is 2.0.

Table 4. Summary of 360T021 Factory Joint Insulation Safety Factors

Joint	Station (inches)	Min. Compliance Safety Factor (CSF) *	Degree Location	Min. Actual Safety Factor (ASF) *	Degree Location
Aft Dome/ Stiffener LH	56.0	3.42	0.0	3.98	0.0
Aft Dome/ Stiffener RH	56.0	3.57	226.8	4.23	226.8
Aft Stiffener/ Stiffener LH	177.7	2.18	0.0	3.36	0.0
Aft Stiffener/ Stiffener RH	177.7	2.38	180.0	3.56	180.0
Aft Stiffener/ET Attach LH	299.1	3.25	90.0	5.00	90.0
Aft Stiffener/ET Attach RH	299.1	2.82	226.8	4.53	226.8
Aft Ctr LH	161.4	1.22**	270.0	3.54	270.0
Aft Ctr RH	161.4	1.87***	270.0	4.81	270.0
Fwd Ctr LH	161.4	3.47	270.0	9.10	270.0
Fwd Ctr RH	161.4	2.02	226.0	5.38	226.0
Forward Cyl./Cyl. LH	162.0	2.67	286.0	3.96	286.0
Forward Cyl./Cyl. RH	162.0	3.96	286.0	5.47	286.0
Forward Dome/ Cyl. LH	321.0	2.91	286.0	3.46	286.0
Forward Dome/ Cyl. RH	321.0	2.99	154.0	3.52	154.0

* Minimum required joint insulation safety factor is 2.0.

** Preliminary PFAR 45C-15 written for apparent CSF violation.

*** Preliminary PFAR 45C-16 written for apparent CSF violation.

Table 5. Summary of 360T021 Case Acreage Insulation Safety Factors

Segment	Min. Compliance Safety Factor (CSF) *	Station (inches)	Degree Location	Min. Actual Safety Factor (ASF) *	Station (inches)	Degree Location
Aft Dome, LH	2.28	45.0	270.0	2.46	45.0	270.0
Aft Dome, RH	2.26	45.0	90.0	2.51	45.0	90.0
Aft, LH	2.06	158.5	226.8	2.07	145.5	0.0
Aft, RH	1.88	145.5	136.8	1.90	145.5	136.8
Aft Ctr, LH	1.22**	161.4	270.0	2.57	71.5	136.0
Aft Ctr, RH	1.27***	30.7	0.0	1.93	30.7	0.0
Fwd Ctr, LH	2.91	163.0	270.0	4.22	126.0	316.0
Fwd Ctr, RH	2.02	161.4	226.0	5.38	161.4	226.0
Forward, LH	2.02	263.0	286.0	2.15	263.0	286.0
Forward, RH	2.05	312.0	286.0	2.30	187.0	154.0

* Minimum required case acreage insulation safety factor is 1.5.

** Preliminary PFAR 45C-15 written for apparent CSF violation.

*** Preliminary PFAR 45C-16 written for apparent CSF violation.

1.1.1 Igniter

A summary of the igniter safety factors are shown in Tables 6 and 7. All safety factors for the igniter can be found in Appendix E, Tables 21 and 22. The igniter insulation condition was typical of past flight motors.

1.1.2 Igniter Nozzle Insert

LH

The postflight insert throat diameter measurements were 6.534 inches at 0 degrees, 6.508 inches at 60 degrees, and 6.588 inches at 120 degrees. Using the maximum postfire measurement provides a thermal factor of safety of 5.7.

RH

The postflight insert throat diameter measurements were 6.569 inches at 0 degrees, 6.649 inches at 60 degrees, and 6.621 inches at 120 degrees. Using the maximum postfire measurement provides a thermal factor of safety of 5.1.

Table 6. Summary of 360T021 Igniter Insulation Safety Factors

Description	Min. Compliance Safety Factor (CSF) *	Station	Degree Location	Min. Actual Safety Factor (ASF) *	Station	Degree Location
LH Igniter Chamber OD	2.80	3	150.0	3.07	3	150.0
RH Igniter Chamber OD	2.65	3	270.0	2.90	3	270.0
LH Igniter Chamber ID	6.74	9	270.0	7.17	9	270.0
RH Igniter Chamber ID	4.55	9	0.0	4.92	9	0.0
LH Adapter	4.65	11	240.0	5.64	11	240.0
RH Adapter	3.86	11	180.0	4.68	11	180.0
LH Inner Joint	4.79	10	270.0	4.95	10	270.0
RH Inner Joint	2.98	10	60.0	3.13	10	60.0
LH Outer Joint	3.31	403**	286.0	4.01	403**	286.0
RH Outer Joint	3.49	403**	206.0	4.28	403**	206.0

* Minimum required safety factors are 1.5 for the chamber and adapter acreage and 2.0 for the igniter joints.

** Forward dome outer joint station (inches).

Table 7. Summary of 360T021 Igniter Insulation at Station 5

Description	Minimum Postflight Thickness (inches)	Degree Location
LH	0.104	330.0
RH	0.088	0.0

Note: The minimum required thickness is 0.010 inch.

4.1.6 Results of Special Issues and Concerns (Insulation)

TWR-60635 identified areas for special evaluation for 360T021. The single insulation issue is listed below with the results.

1. Condition: Asymmetric erosion (pocketing) was identified on the internal insulation on the aft dome to stiffener factory joint on FSM-1, and RSRM-13. Other aft dome factory joints which have been evaluated at KSC include RSRM-12, RSRM-11, and RSRM-14 through RSRM-20. Minor occurrences have been seen on several of the aft dome factory joints on theses segments.

During the investigation of this condition, a similar surface condition was visible on internal insulation on the forward ramp of the aft dome factory joint of the recently cured RSRM-21A aft segment. Several profile plots were taken at the high and low surfaces at this joint.

Results: Asymmetric erosion regions were observed at the aft dome factory joint during postflight inspection at KSC. Profile plots were taken at these areas after segment rinse by Thermal Insulation Design. The prefire profile plots were compared against the postfire plots. The conditions noted prefire were in the same locations as the asymmetric erosion noted postfire. This indicates that the "asymmetric erosion" is primarily a result of prefire insulation layup rather than actual erosion.

Asymmetric erosion patterns had been previously identified on the stiffener-to-stiffener and aft dome factory joints of several flight and static test motors. The most severe evidence of asymmetric erosion occurred on the RSRM-13 aft segments.

As part of the asymmetric erosion investigation, prefire insulation contours were examined on the RSRM-21 aft segments which had recently completed insulation cure. There was a significant difference observed during the visual examination of these two segments. The RSRM-21B segment showed contours which were fairly smooth and uniform, while the forward ramp region on RSRM-21A showed surfaces which was similar to the postflight contours identified on RSRM-13. Prefire contour maps were taken at several locations of the RSRM-21A aft dome factory joint. Comparison plots, shown in Figure 1-5, Appendix E, provide the prefire and postflight contour maps taken on the RSRM-21A aft segment. These plots show that the prefire and postflight contours were very consistent, with only a slight increase in erosion seen on the forward ramp. No other areas of asymmetric erosion were identified. Engineering felt that the asymmetric erosion identified on previous motors was actually a product of the prefire insulation contour.

The erosion identified on the forward ramp appears to be a result of normal flow over the factory joint. A propellent void or other defect in this region would result in erosion toward the casewall, as well as into the ramp, which is not evident in these regions.

4.2 Case, Seals, and Joints

Seal and joint evaluations of the S&As, factory joints, nozzle internal joints, and leak check port plugs were performed. PFORs documenting the observations are found in Appendix B.

4.2.1 S&A

Figure 2 shows the Safe and Arm device (S&A) configuration. The following is a summary of the assessment observations.

LH

Typical sooting was observed up to but not past the forward primary rotor shaft O-ring. Soot was not observed past any pressure seal.

Medium-to-heavy corrosion was observed on the entire surface of the rotor shaft spring. Corrosion on the spring had not been previously reported. Preliminary PFAR 45C-11 was written.

Foreign material (copper-like) was observed on the OD surface of the rotor shaft secondary seals. The material appears to have been introduced during the leak test of the primary and secondary seals. This B-B was assembled prior to a change implementing use of an in-line air filter which should correct this condition. Preliminary PFAR 45C-12 was written.

Foreign material (green particles) was observed in the ullage cavity region of the rotor. Preliminary PFAR 45C-13 was written.

Material was missing from the last two threads of the 198-degree SII. No raised metal was observed. Preliminary PFAR 45C-14 was written.

RH

No anomalous conditions were observed.

Typical sooting was observed up to but not past the forward primary rotor shaft O-ring. Soot was not observed past any pressure seal.

Typical manufactured deformations were observed on the seal washer of both SIIs from both S&A devices.

4.2.2 Case Factory Joints

The factory joints were inspected by Quality Assurance at Clearfield. All fourteen factory joints were in good condition with no heavy corrosion on any of the joints. No O-ring heat effect or erosion was observed.

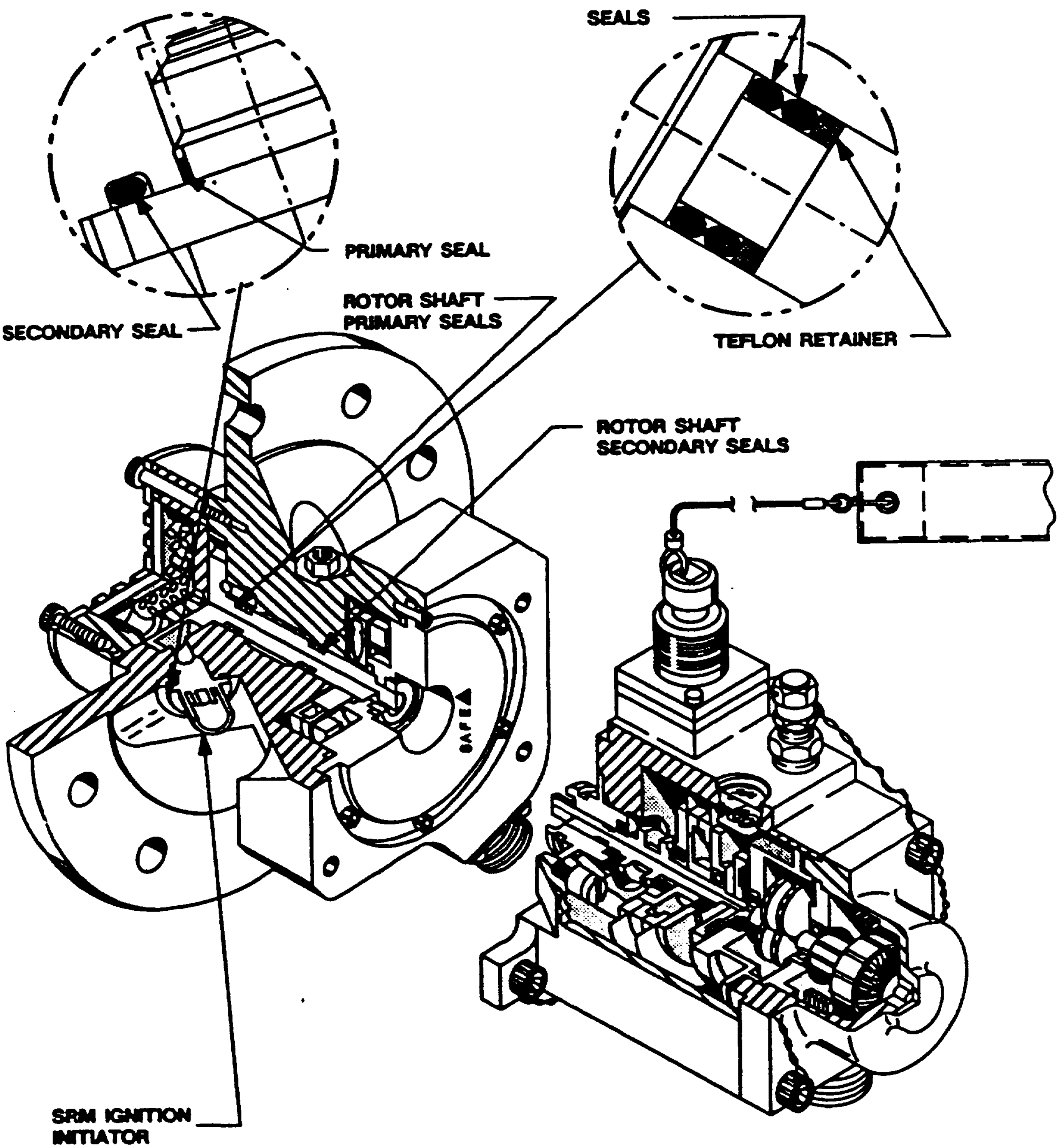


Figure 2. Safe and Arm Device Seals

4.2.3 Internal Nozzle Joints and Seals

Details concerning the nozzle internal joint performance can be found in Section 4.3.

4.2.4 Port Plugs and Port Plug Seals

S&A
There were no anomalous conditions observed on the S&A leak test ports, plugs, or O-rings.

Factory Joints
There was no heavy corrosion observed in any of the leak check ports.

Internal Nozzle Joints
A scratch was observed on the underside of the leak test plug head and could be felt with a 5-mil brass shim stock. The scratch was approximately 0.20 inch long with one end approximately 0.07 inch from the plug shank and was continuous to the outside edge of the plug head. Preliminary PFAR 45C-07 was written.

4.2.5 Results of Special Issues and Concerns (Case, Seals, and Joints)

1. Condition: The LH forward stiffener segment has been scheduled for limited use. The letter "L" was branded on the part adjacent to the weather seal at the forward end of the segment.

Results: The letter "L" was relocated next to the part number in accordance with the DR disposition (reference DR 123069-01).

2. Condition: Discoloration exists on the RH lightweight attach case cylinder tang extending forward 3.0 inches maximum at 0 degrees and circumferentially from 354-0-6 degrees on the inside diameter.

Results: The assessment of this factory joint was performed as required in the PEEP. No anomalous conditions were noted.

3. Condition: The nozzle fixed housing forward end bolt chamfers and spotfaces have previously been affected by the glass beading operation during refurbishment. Material was deformed or removed from the edge of the chamfer. This condition, along with defects to the Packing with Retainer (P/R) and fixed housing spotface could compromise the P/R seal. A similar condition may exist on this flight set.

Results: The spotfaces and chamfers of both fixed housings were assessed and no rounding, deformation or other metal damage was observed. Only typical disassembly damage was observed on the Packings with Retainers.

4. Condition: A recent seals audit identified discrepancies between the Refurbishment and process finalization specifications (STW7-3434 and STW7-3450, respectively) and Engineering requirement drawings. The specifications do not provide adequate criteria to define the throat support housing forward and aft seal surfaces of nozzle Joints 3 and 4.

Results: The throat support housing forward end sealing surface was assessed and no seal surface damage or corrosion was observed. Heavy corrosion was observed on the aft end seal surface of both the LH and RH throat support housings and was documented on Preliminary PFARs 45C-02 and 45C-01, respectively. No other seal surface damage was observed.

4.3 Nozzle

Figure 3 defines the internal joint nomenclature and details the internal nozzle joint configuration used in this report. PFORs documenting the observations are included in Appendix C.

The condition of the 360T021 nozzle internal joints was generally typical of previous flight nozzles. RTV was below the char line in all joints. The primary and secondary O-rings in all joints showed no signs of blowby, erosion, heat effect or disassembly damage. There was no significant metal hardware damage.

The following sections provide detailed assessments of nozzle internal joints, bondline conditions, char and erosion performance, flex boot and flex bearing condition, and throat erosion data. Detailed bondline inspections were conducted after insulation was removed on all subassemblies. The outcome of special issues and concerns for this nozzle flight set is presented in Section 4.3.19.

4.3.1 Nose Inlet/Flex Bearing (Joint 2)

LH

There was mixing of RTV and EA913NA adhesive, which is a normal condition for this joint. RTV was below the char line around the full circumference. Typical amounts of soot entered the joint between the layers of RTV and adhesive. Soot reached the primary O-ring intermittently around the circumference. The heaviest area of soot was from 336-0-96

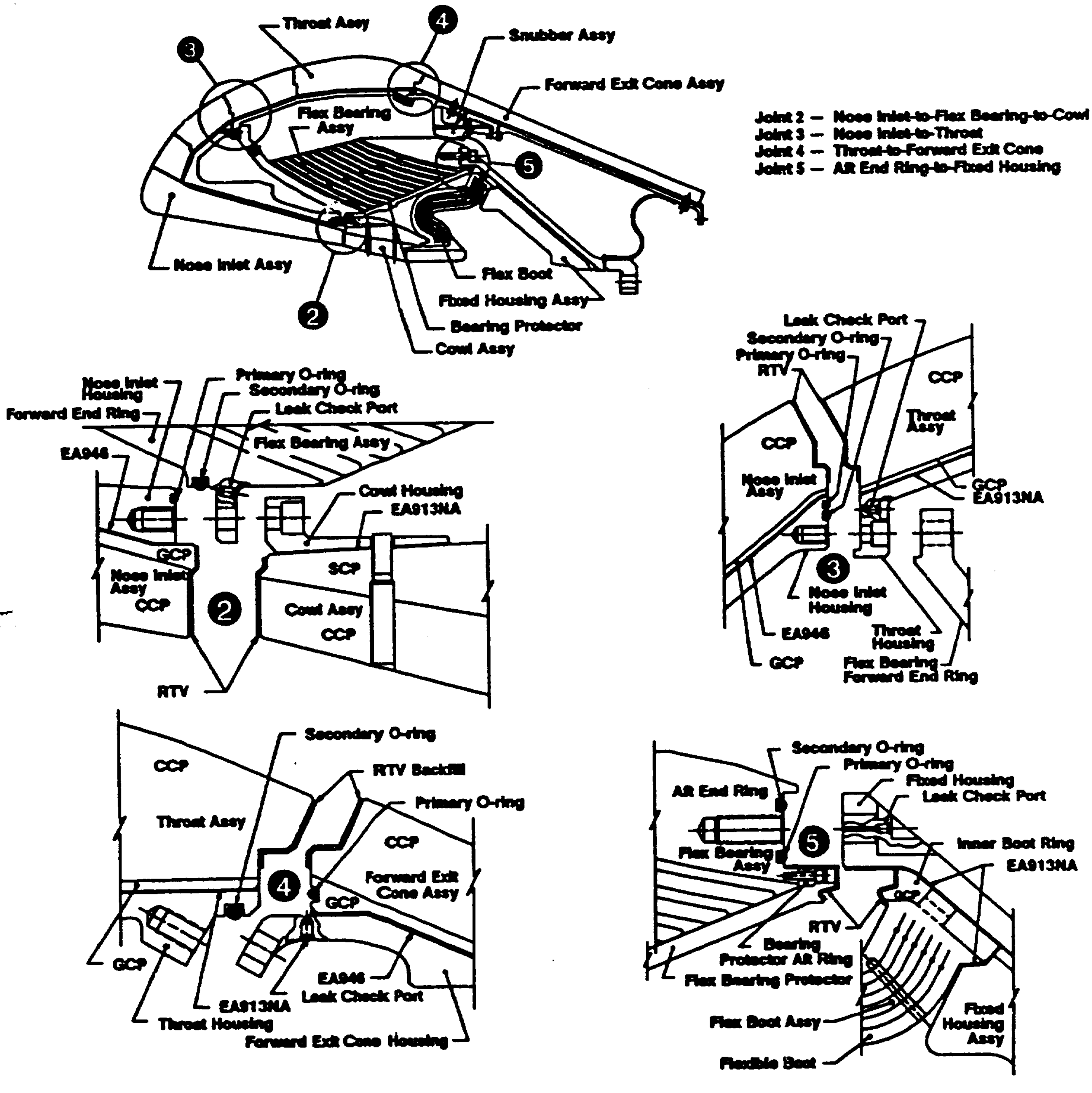


Figure 3. RSRM Nozzle Internal Joints

degrees. No distinct gas paths were observed. There were no heat effects to the metal, phenolics, or O-rings.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was observed in the nose inlet housing bolt holes. Light-to-medium corrosion was observed on the forward end ring flange and the cowl housing. No other metal damage was observed.

No bondline separations were observed on the nose inlet assembly or cowl assembly.

RH

This joint also showed mixing of RTV and adhesive, with RTV below the char line around the complete circumference. Soot entered the joint between the layers of RTV and adhesive and reached the primary O-ring intermittently around the circumference. One gas path was found at 10 degrees.

Foreign material was found on the primary O-ring and on the downstream side of the O-ring at 13, 14, and 17 degrees. Preliminary PFAR 45C-06 was written as a result of this condition. Samples of the material were taken for laboratory analysis. The material was found to be a mixture of soot, HD-2 grease, and methyl chloroform. It was determined that this material was not present during motor operation but was introduced at disassembly. Methyl chloroform is used to clean the threads in the three forward end ring jacking screw holes just prior to joint demate. If excess methyl chloroform is used, it can spread out away from the hole, pick up contaminants such as soot and grease, and deposit them in areas where they are not normally seen. There were no heat effects to the metal, phenolics, or O-rings.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the nose inlet housing bolt holes. Medium corrosion was observed on the cowl housing. The forward end ring flange forward side had light-to-medium corrosion. No other metal damage was observed.

No bondline separations were observed on either the nose inlet assembly or cowl assembly.

4.3.2 Nose Inlet/Throat Housing (Joint 3)

LH

The RTV reached below the char line around the full circumference. No gas paths were seen in this joint.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Light-to-medium corrosion was visible on the inboard edges of the throat housing and nose inlet housing joint metal surfaces. No other metal damage was observed.

Separations within the CCP were observed on the throat assembly with a maximum radial width of 0.05 inch at the following locations: 357–0–23, 48-to-68, 132-to-142, and 269-to-275 degrees. No bondline separations were seen on the nose inlet assembly.

RH

RTV was below the char line around the full circumference, and reached the primary O-ring from 135-to-143 degrees. Uncured RTV was found at the deepest part of the joint from 120-to-140 degrees. No gas paths were seen in this joint.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the bolt holes. Light corrosion was visible on the inboard edge of the throat housing intermittently around the circumference.

Metal-to-adhesive separations were observed at the forward end of the throat assembly with a maximum radial width of 0.005 inch. The separations were seen intermittently around the circumference.

4.3.3 Throat/Forward Exit Cone (Joint 4)

LH

The RTV was below the char line over the full circumference of the joint, and reached the primary O-ring around 90 percent of the circumference. No gas paths were seen in the RTV. Grease did not interfere with the RTV backfill in the joint.

Grease coverage on the joint metal surfaces was nominal. Intermittent medium-to-heavy corrosion was observed on the throat aft end primary O-ring sealing surface. Intermittent medium-to-heavy corrosion was also observed on the forward exit cone axial metal surface between the secondary O-ring and adhesive bondline. The heavy corrosion extended onto the secondary sealing surface from 25-to-35 and at 190 degrees. Preliminary PFARs 45C–02 and 45C–03 were written as a result of these conditions.

Eleven snubber axial shim retainers and bolts were damaged due to splashdown. Four of the retainer bolts were fractured. No other metal damage was observed.

A metal-to-adhesive separation was observed on the forward exit cone assembly forward end from 300–0–30 degrees with a maximum radial width of 0.040 inch. A metal-to-adhesive separation was also observed on the throat assembly aft end around the complete circumference with a maximum radial width of 0.022 inch.

RH

The RTV was below the char line around the entire joint circumference, and reached the primary O-ring over 75 percent of the circumference. There were no gas paths in the RTV. Grease did not interfere with the RTV backfill.

Grease coverage on the joint metal surfaces was typical. Medium-to-heavy corrosion was observed on the throat aft end primary O-ring sealing surface intermittently around the circumference. Pitting was seen in this area. Preliminary PFAR 45C-01 was written as a result of this condition. No other metal damage was observed.

A metal-to-adhesive separation was observed on the throat aft end around the entire circumference. The maximum radial width of this separation was 0.040 inch. Two CCP-to-GCP separations were observed on the forward exit cone assembly from 65-to-120 and 140-to-215 degrees. The maximum radial width of these separations was 0.060 inch.

4.3.4 Flex Bearing/Fixed Housing (Joint 5)

LH

The RTV coverage in this joint was typical and reached the primary O-ring at 300 degrees. Intermittent encapsulated voids were observed in the RTV due to the assembly process. An area of foreign material was found between the primary and secondary O-ring grooves at 352 degrees. The material was confirmed by laboratory analysis to be RTV and measured approximately 0.50 inch in diameter. Preliminary PFAR 45C-04 was written.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the aft end ring bolt holes. Intermittent medium-to-heavy corrosion was observed on the inboard aft tip of the aft end ring. No other metal damage was observed.

Typical sooting was seen on the bearing protector and flex boot ID. No bondline separations were observed between the inner boot ring and the fixed housing.

Typical disassembly damage was observed on 61 of the 72 Packings with Retainers.

RH

The RTV coverage was nominal but did not reach the primary O-ring. Intermittent encapsulated voids were observed in the RTV due to the assembly process.

Grease coverage on the joint metal surfaces was nominal. No excessive grease was found in the aft end ring bolt holes. Intermittent medium-to-heavy corrosion was observed on the inboard aft tip of the aft end ring. No other metal damage was observed.

Typical sooting was seen on the bearing protector and flex boot ID. No bondline separations were observed between the inner boot ring and the fixed housing.

Typical disassembly damage was observed on 67 of the 72 Packings with Retainers.

4.3.5 Aft Exit Cone Bondlines

LH

The separation mode was 5 percent metal-to-adhesive, 5 percent within the adhesive, and 90 percent within the GCP. No corrosion was seen on the metal surfaces. The largest adhesive void measured 3.25 inches axially by 1.80 inches circumferentially. This void was located 41.75 inches from the forward end at 340 degrees.

RH

The separation mode was 5 percent metal-to-adhesive and 95 percent within the GCP. No corrosion was observed. The largest adhesive void measured 3 inches axially by 1 inch circumferentially and was located one inch from the forward end at 22 degrees. Intermittent small voids were seen in the polysulfide around the full circumference.

4.3.6 Forward Exit Cone Bondlines

LH

The separation mode was 17 percent metal-to-adhesive, 25 percent within the adhesive, and 58 percent adhesive-to-GCP. Medium-to-heavy corrosion was seen in the areas of metal-to-adhesive separation. A total of 18 adhesive voids exceeding 0.5 inch in diameter were found.

RH

The separation mode was 31 percent metal-to-adhesive, 19 percent within the adhesive, and 50 percent adhesive-to-GCP. Medium-to-heavy corrosion was seen in the areas of metal-to-adhesive separation. A total of nine adhesive voids exceeding 0.5 inch in diameter were found.

4.3.7 Throat Assembly Bondlines

LH

The throat inlet ring separation mode was 25 percent metal-to-adhesive, 10 percent adhesive-to-GCP, 10 percent within the GCP, and 55 percent GCP-to-CCP. The throat ring mode was 100 percent metal-to-adhesive. Medium-to-heavy corrosion was observed in the areas of metal-to-adhesive separations. Four branch-shaped voids were found in the throat ring bondline near the aft end. These voids are typical observations in the throat ring and are caused by air entrapment during the bonding process.

RH

The separation mode for both the throat inlet and throat rings was 100 percent metal-to-adhesive, which is within the RSRM experience base. Heavy corrosion was seen over 95 percent of the bond surface. Typical bondline voids were seen near the aft end of the throat ring.

4.3.8 Nose Inlet -503/-504 Rings Bondlines

LH

The separation mode was 78 percent metal-to-adhesive, 7 percent within the adhesive, and 15 percent adhesive-to-CCP. Medium-to-heavy corrosion was observed in the areas of metal-to-adhesive failure. Two voids exceeding 0.5 inch in diameter were present in the forward nose ring bondline.

RH

The separation mode was 96 percent metal-to-adhesive, 1 percent within the adhesive, and 3 percent adhesive-to-CCP. Light-to-heavy corrosion was seen intermittently over the full length and circumference. Only one void exceeding 0.5 inch in diameter was found.

4.3.9 Nose Cap Bondlines

LH

The separation mode was 10 percent within the GCP and 90 percent GCP-to-CCP. When the remaining GCP was removed from the housing, the secondary failure mode was 4 percent metal-to-adhesive and 96 percent adhesive-to-GCP. Medium corrosion was seen in the areas of metal-to-adhesive separations. Two voids exceeding 0.5 inch in diameter were observed in the nose cap bondline.

RH

The separation mode was 5 percent within the GCP and 95 percent GCP-to-CCP. Upon removal of the remaining GCP, the secondary failure mode was 10 percent metal-to-adhesive and 90 percent adhesive-to-GCP. Intermittent light-to-heavy corrosion was seen on the forward 3 inches and aft 2 inches of the metal bonding surface around the full circumference. A total of five voids were found that exceeded 0.5 inch in diameter.

4.3.10 Cowl Assembly Bondlines

LH

The separation mode was 100 percent metal-to-adhesive. Heavy corrosion was seen full circumference on the metal bond surface and on the chamfer at the forward end of the cowl housing. A total of eight bondline voids were found, and all were in line with the shear pin holes. Several of these voids showed RTV intrusion from the cowl-to-nose cap radial bondline.

RH

The separation mode was 100 percent metal-to-adhesive. Heavy corrosion was seen full circumference on the metal bond surface and on the chamfer at the forward end of the cowl housing. Four bondline voids, all in line with shear pin holes, were seen.

Soot was observed in the bondline at 10 degrees. The soot was at the forward edge of the bondline and measured 0.75 inch axially by 1.20 inches circumferentially. Preliminary PFAR 45C-08 was written as a result of this condition.

4.3.11 Fixed Housing Assembly Bondlines

LH

The primary separation mode was 30 percent metal-to-adhesive, 50 percent adhesive-to-GCP, and 20 percent within GCP. Upon removal of the remaining GCP, the secondary failure mode was 100 percent adhesive-to-GCP. The 30 percent metal-to-adhesive primary separation mode was outside of the RSRM experience base. Preliminary PFAR 45C-09 was written.

Several areas on the ID of the GCP bonding surface appeared to have been inadequately grit blasted, resulting in the adhesive-to-GCP failure mode. Preliminary PFAR 45C-10 was written as a result of this condition. No voids exceeding 0.5 inch in diameter were found.

RH

The primary separation mode was 67 percent within the GCP, 32 percent GCP-to-CCP, and less than 1 percent for both adhesive-to-GCP and within the CCP. Upon removal of the remaining phenolics, the secondary failure mode was greater than 99 percent adhesive-to-GCP and less than 1 percent metal-to-adhesive. Intermittent resin rich areas were seen at the forward and aft end of the GCP bonding surface. A total of eight voids exceeding 0.5 inch in diameter were found. The largest void was at 28 degrees, four inches from the aft end of the bondline surface, and measured 1.0 inch axially by 0.4 inch circumferentially.

4.3.12 Ultrasonic Inspection of Fixed Housings

A steel-side ultrasonic inspection of both fixed housing assemblies was conducted prior to washout. The purpose of this inspection was to detect any voids or unbonds present in the adhesive bondline.

The condition of the fixed housing bondlines as determined by the ultrasonic inspections was generally satisfactory and was typical of previous flight fixed housings. Several scattered adhesive voids less than one inch in diameter were found on both fixed housings; however, no large, continuous voids or unbonds were detected.

4.3.13 Char and Erosion

Char and erosion margins of safety are summarized in Table 8. The char and erosion data tables for each component liner can be found in Appendix D. Measurement stations showing blank lines means that data was not available due to missing material. All stations showed positive margins of safety. There is no char and erosion data for the aft exit cone due to the loss of the carbon phenolic liner at splashdown.

Table 8. 360T021 Nozzle Char and Erosion Minimum Margins of Safety Summary

Hardware	Stations*												
Fwd Exit Cone — LH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	0.37	0.26	0.26	0.27	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Fwd Exit Cone — RH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	0.33	0.26	0.25	N/A	N/A	N/A	N/A	N/A	0.20	0.15	0.20	0.45	
Throat Assembly — LH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.16	0.14	0.14	0.09	0.07	0.17	0.24	0.28	0.33	0.38	0.43	0.43	0.27
Throat Assembly — RH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.15	0.15	0.12	0.09	0.06	0.19	0.24	0.24	0.31	0.37	0.45	0.46	0.30
Fwd Nose (-503) and Aft Inlet (-504) Rings — LH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.23	0.39	0.23	0.35	0.37	0.21	0.16						
Fwd Nose (-503) and Aft Inlet (-504) Rings — RH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.21	0.28	0.13	0.32	0.32	0.21	0.18						
Nose Cap Assembly — LH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	N/A	0.50	0.55	0.61	0.74	0.69	0.84	0.66	0.59	0.55	0.14	0.07	0.12
Nose Cap Assembly — RH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	0.39	0.50	0.56	0.58	0.68	0.60	0.60	0.56	0.52	0.43	0.18	0.05	0.11
Cowl/OBR — LH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.23	0.25	0.19	0.15	0.31	N/A	0.13	0.20	0.07	0.68	0.63	0.57	
Cowl/OBR — RH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.14	0.09	0.09	0.10	0.19	0.28	0.16	0.34	0.42	0.64	0.71	0.52	
Fixed Housing — LH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	1.76	0.93	0.69	0.65	0.68	0.78	0.80	0.80	1.06	1.82	0.18		
Fixed Housing — RH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	1.97	0.75	0.72	0.68	0.71	0.70	0.71	0.80	0.93	1.55	0.23		

* Station locations are shown in bold with the margin of safety shown below.

4.3.14 Flex Boot Performance

The performance of both the flex boots was nominal. Typical even sooting was present on the flexible boot ID of both nozzles. Both flex boots had a minimum 3.1 NBR plies intact. Positive margins of safety were observed at all sections. The flex boot performance margins of safety are summarized in Table 9.

Table 9. 360T021 Flex Boot Margins of Safety

	Left Hand			Right Hand		
Degree Location	Remaining Plies	Max. Material Affected Depth (in.)	Performance Margin of Safety	Remaining Plies	Max. Material Affected Depth (in.)	Performance Margin of Safety
0	*3.4	1.27	0.31	3.2	1.34	0.24
90	3.1	1.37	0.21	3.1	1.37	0.21
180	3.1	1.37	0.21	3.2	1.34	0.24
270	3.1	1.37	0.21	3.1	1.37	0.21

* Minimum flex boot overall prefire thickness is 2.5 inches.

4.3.15 Bearing Protector Performance

Close examination showed both of the bearing protectors performed as expected during flight. Both of the protectors were evenly sooted on the OD around the full circumference and showed greater erosion in line with the cowl vent holes. There was no evidence of heat effect on the flex bearing side of either bearing protector. The postflight bearing protector thickness measurements are in Appendix C.

Axial cracks were observed in the aft GCP bearing protector ring on both nozzles. Three cracks were seen in the LH nozzle, and two cracks in the RH nozzle. All cracks were lined up with the screw holes drilled through the GCP ring.

Four of the attach bolts in the LH forward GCP bearing protector ring were fractured flush with the aft face of the cowl housing. Preliminary PFAR 45C-05 was written. No bent bolts were observed following removal of the bearing protectors.

4.3.16 Cowl Housing Insulation Segments Performance

The performance of the cowl housing insulation segments was nominal. Both the LH and RH segments were evenly sooted around the full circumference and showed typical surface heat effects. Surface blisters were seen on the LH segments from 110-to-215 degrees, and on the RH segments from 315-0-220 degrees.

Following removal from the cowl housing, the insulation segment bondlines showed no abnormal heat effect or erosion. No soot was seen in either bondline.

4.3.17 Flex Bearing

LH

The flex bearing performance during flight was acceptable. There were no anomalies associated with flight or splashdown. Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications. Intermittent medium-to-heavy corrosion was seen on the aft ID tip of the bearing aft end ring over 10 percent of the circumference.

RH

The flex bearing performance during flight was acceptable. There were no anomalies associated with flight or splashdown. Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications. Intermittent medium-to-heavy corrosion was seen on the aft ID tip of the bearing aft end ring over 10 percent of the circumference.

4.3.18 Throat Diameter

The average LH nozzle postfire throat diameter was 55.929 inches which yields an erosion rate of 8.28 mils/second based on an action time of 125.0 seconds. The average RH nozzle postfire throat diameter was 55.790 inches which yields an erosion rate of 7.67 mils/second based on an action time of 125.8 seconds. RSRM postfire throat diameters have ranged from 55.787-to-56.048 inches.

4.3.19 Results of Special Issues and Concerns (Nozzle)

TWR-60635 identified areas for special evaluation for 360T021. The nozzle issues are listed below with their respective results.

1. **Condition:** Low Density Indications (LDIs) were found in the LH nozzle adhesive bondlines between the nose cap and forward nose ring, and between the nose cap GCP and nose inlet housing.

   Results: The prefire LDI documented at 242 degrees correlated well with an adhesive void found at 244 degrees (see PFOR, pages C-19 and C-19A). The remaining documented prefire LDIs were not found.

2. **Condition:** Blemishes were found on the LH nozzle CCP surface at the aft end of the cowl and the forward end of the outer boot ring. The worst case blemish was 0.058 inch deep at the aft end of the cowl at 180 deg.

   Results: Erosion and char at 180 degrees was within the RSRM experience base. No unusual conditions were seen.

3. Condition: The ID surface of the LH cowl silica cloth insulator was contaminated with EA913NA adhesive. The excess adhesive was sanded off prior to bonding the cowl to the cowl housing.

Results: The bond surface appearance and failure mode was typical of previous RSRM nozzle cowls. No evidence of bond contamination was seen.

4. Condition: The LH cowl spring pin hole at 100 deg was drilled approximately 0.15 inch too deep into the cowl insulation segment.

Results: No unusual conditions were observed. The hole did not extend through the insulation segment postfire thickness.

5. Condition: LDIs were seen in the LH cowl housing adhesive bondline.

Results: Four adhesive voids were found which correlated with the prefire LDIs.

6. Condition: LDIs were found in the RH nozzle adhesive bondline between the nose cap GCP and nose inlet housing.

Results: Four adhesive voids were found which correlated with the prefire LDIs.

7. Condition: LDIs were seen in the RH cowl housing adhesive bondline.

Results: Two adhesive voids were found which correlated with the prefire LDIs.

8. Condition: Two LDIs were found in the RH aft exit cone GCP at the forward end.

Results: The area of the cone that contained the LDIs was sectioned, polished, and photographed. No evidence of a delamination or porous area was found.

9. Condition: LDIs were found within the RH nose cap GCP.

Results: Condition could not be evaluated due to the destructive nature of the GCP removal process during washout.

10. Condition: The LH nozzle flex bearing has been scheduled for limited use.

Results: Subsequent to disassembly, a change in the flex bearing unbond criteria resulted in this bearing being fully compliant with engineering requirements. Therefore, per MRB action the "L" has been removed from the bearing part number.

TWR-60695

Appendix A
Insulation PFORs

Final Postflight Hardware Evaluation Report 360T021 (RSRM-21, STS-45)

October 1992

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4784

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

INSULATION REQUIRED PFOR LIST

PFOR #	Title	Side	Joint or Location	Final Report Page Number
A-1	Postfire Insulation CPI Log Numbers	Left	N/A	A-1
A-2	Segment Internal Insulation Condition	Left	Forward Segment	A-2
A-2	Segment Internal Insulation Condition	Left	Forward Center Segment	A-3
A-2	Segment Internal Insulation Condition	Left	Aft Center Segment	A-4
A-2	Segment Internal Insulation Condition	Left	Aft Segment	A-5
A-8	Igniter Nozzle Insert Throat Diameter Measurements	Left	Igniter Nozzle Insert	A-6
A-3	Forward Segment Liner Pattern	Left	Forward Segment	A-7
A-4	Forward Center Segment Liner Pattern	Left	Forward Center Segment	A-8
A-5	Aft Center Segment Liner Pattern	Left	Aft Center Segment	A-9
A-6	Aft Segment Liner Pattern	Left	Aft Segment	A-10
A-7	Acreage and Joint Internal Insulation Sample Condition	Left	Forward Center Segment Acreage	A-27

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

INSULATION REQUIRED PFOR LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
A-1	Postfire Insulation CPI Log Numbers	Right	N/A	A-11
A-2	Segment Internal Insulation Condition	Right	Forward Segment	A-12
A-2	Segment Internal Insulation Condition	Right	Forward Center Segment	A-13
A-2	Segment Internal Insulation Condition	Right	Aft Center Segment	A-14
A-2	Segment Internal Insulation Condition	Right	Aft Segment	A-15
A-8	Igniter Nozzle Insert Throat Diameter Measurements	Right	Igniter Nozzle Insert	A-16
A-3	Forward Segment Liner Pattern	Right	Forward Segment	A-17
A-4	Forward Center Segment Liner Pattern	Right	Forward Center Segment	A-18
A-5	Aft Center Segment Liner Pattern	Right	Aft Center Segment	A-19
A-6	Aft Segment Liner Pattern	Right	Aft Segment	A-20
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Forward Center Factory Joint, 0°	A-21
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Forward Center Factory Joint, 120°	A-22
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Forward Center Factory Joint, 240°	A-23

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

INSULATION REQUIRED PFOR LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Fwd Ctr Segment Flap Region, 0°	A-24
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Fwd Ctr Segment Flap Region, 120°	A-25
A-7	Acreage and Joint Internal Insulation Sample Condition	Right	Fwd Ctr Segment Flap Region, 240°	A-26

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-1
Postfire Insulation Common Planning Index (CPI) Log Numbers

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 6 Oct 1992

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen

Record CPI Log and Postfire Part and Serial Numbers Below:

	P/N	PPC No.	Serial No.	CPI Log No.
A. Igniter Chamber	1U75163-01	(907)	0000024	RG190
B. Igniter Adapter	1U50278-12	(902)	1	RA629
C. Forward Segment	1U76790-05	(904)	0000005	4CFIF
D. Forward Center Segment	1U76791-01	(903)	0000015	4CGXG
E. Aft Center Segment	1U76791-01	(903)	0000013	4CFJV
F. Aft Segment	1U76957-03	(904)	0000007	4CFIB

...es / Comments

1 Serial number for RSRM-21A Igniter Adapter washout has not yet been assigned.

...arification Form(s)? ______ Yes X No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: June 25, 1992
Assessment Engineer(s)/Inspector(s): Reo Markley		
Segment: Forward		

Segment Internal Insulation Observations:

	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		✓	
H. Liner Completely Missing? (Center Segments Only)		✓	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		N/A	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: RSRM-21 | Side: ☒ Left (A) ☐ Right (B) | Date: 8/12/92

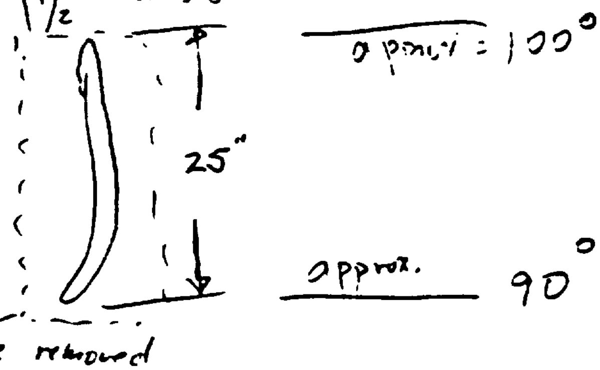
Assessment Engineer(s)/Inspector(s): Reo Mackley

Segment: ☐ Forward ☒ Forward Center ☐ Aft Center ☐ Aft

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		N/A	
H. Liner Completely Missing? (Center Segments Only)		✓	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		N/A	

Notes / Comments

1. 85" fwd of tang 90° - snake-like ridge lies mostly in a circumferential orientation, about 18" long, 1 1/2" wide



After sample was removed per A.O. 4C6-59, no voids were noted between case + insulation (Reference PFOR A-7, page A-27)

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

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Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2

Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: Aug. 4, 1992
Assessment Engineer(s)/Inspector(s): Reo Mackley		
Segment: Aft Center		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		N/A	
H. Liner Completely Missing? (Center Segments Only)		✓	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		N/A	

Notes / Comments

…eliminary PFAR(s)? ______ Yes ___✓___ No Preliminary PFAR Number(s): ______________

…larification Form(s)? ______ Yes ___✓___ No Clarification Form Page No.(s): ______________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: ~~Right (R)~~ (A)	Date: ~~May 27~~, 1992
Assessment Engineer(s)/Inspector(s): Ren Mackley		≈ May 20, 1992
Segment: Aft		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		N/A	
H. Liner Completely Missing? (Center Segments Only)		N/A	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		✓	

Notes / Comments

Special Issue 3.1.1.1 – Aft dome factory joint profile measured by Kevin A. & Norm E. on 5/29/92 (in washout bay).

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-8
Igniter Nozzle Insert Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: July 1992

Assessment Engineer(s)/Inspector(s): BRYAN BAUGH

Record the Igniter Nozzle Insert Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	6.451
60	6.464
120	6.481

Notes / Comments

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

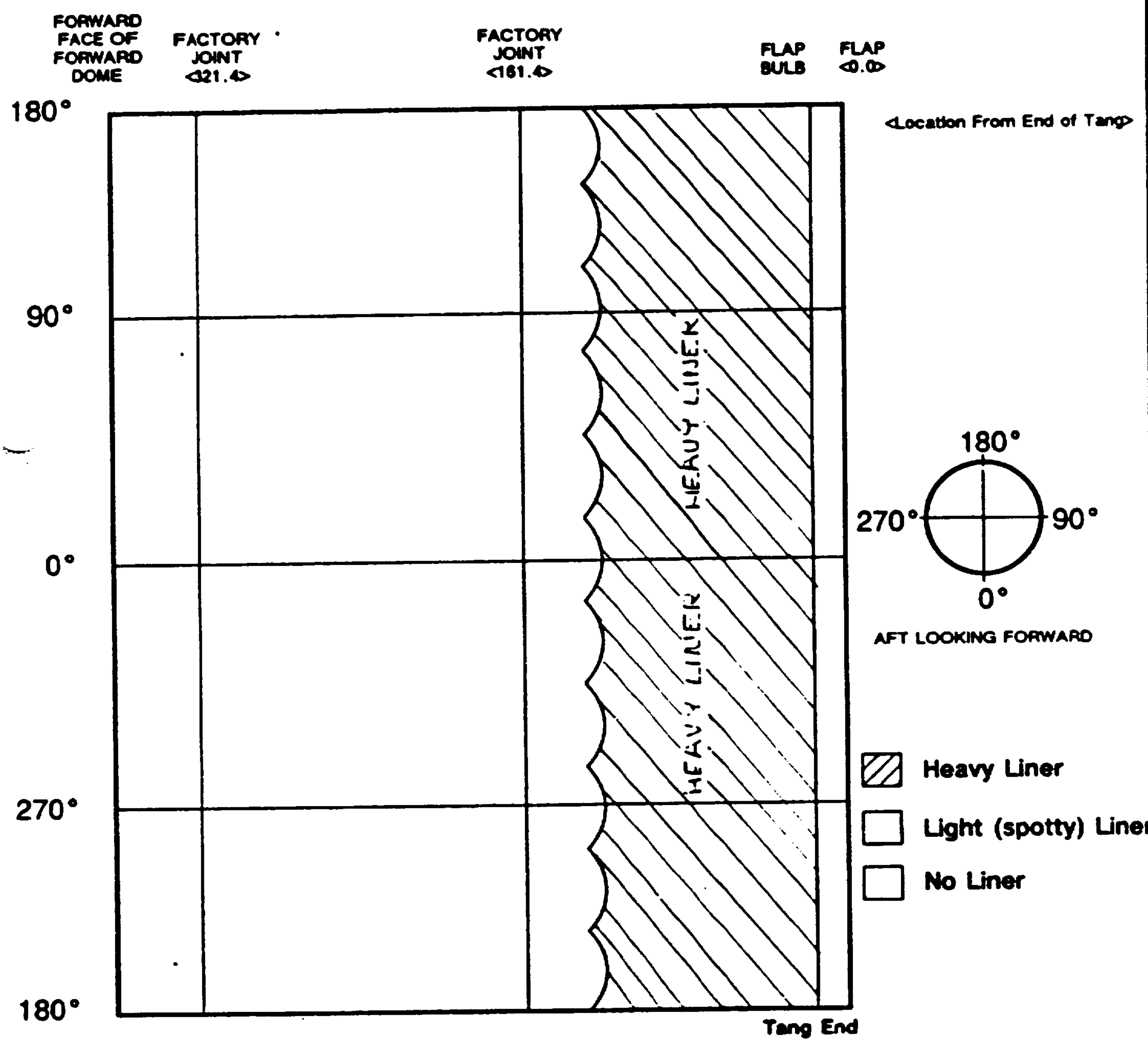
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-3

Forward Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 6-26-92
Assessment Engineer(s)/Inspector(s): SCOTT SPENCER		

Sketch Forward Segment Liner Pattern Observations Below:



Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ___

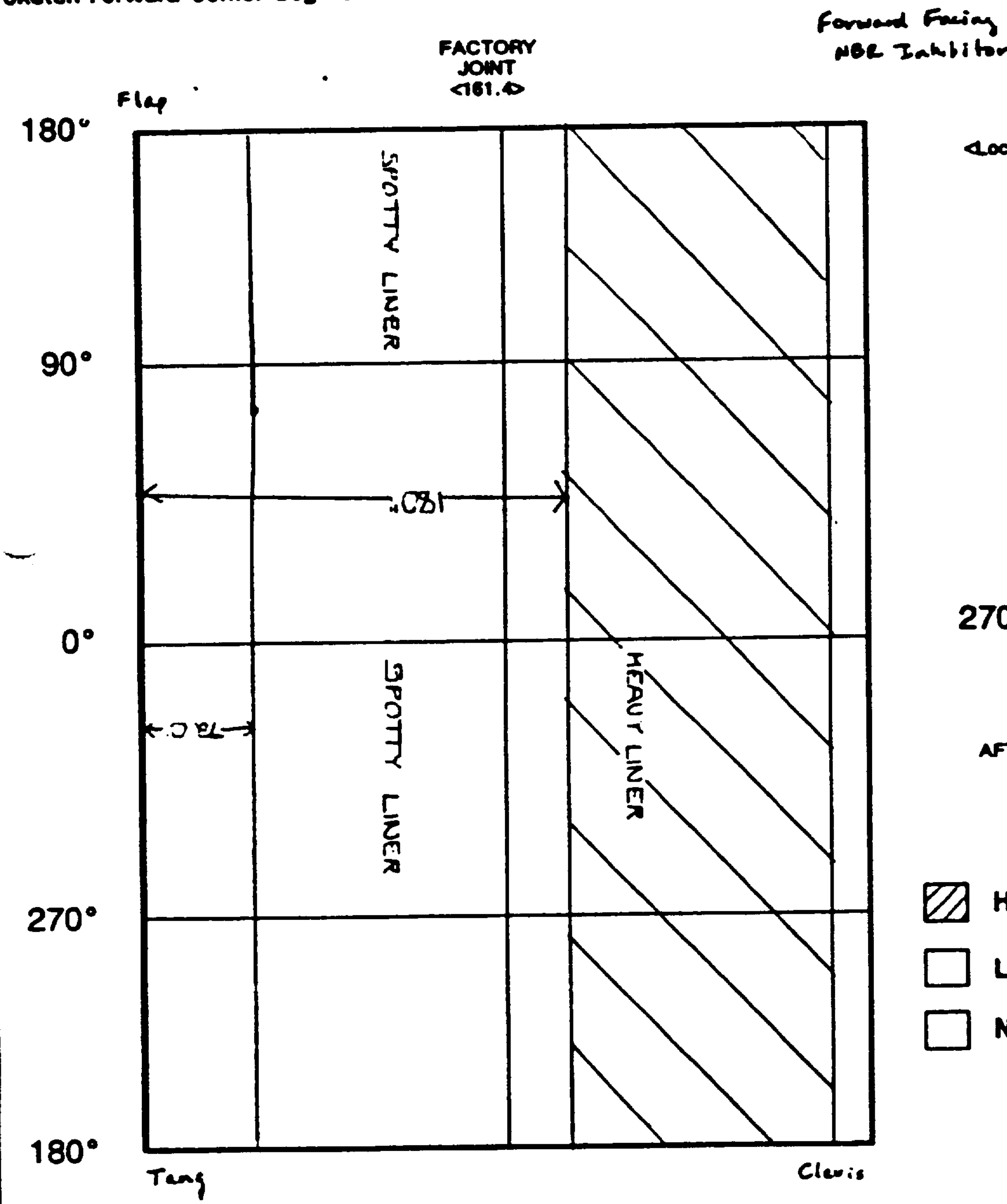
DOC NO. TWR-60695	VOL
SEC	PAGE A-7

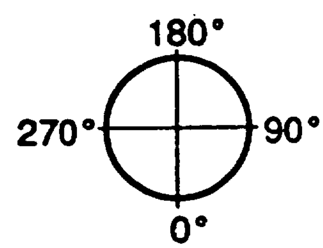
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-4
Forward Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8-12-92
Assessment Engineer(s)/Inspector(s): SCOTT SPENCER		

Sketch Forward Center Segment Liner Pattern Observations Below:





AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

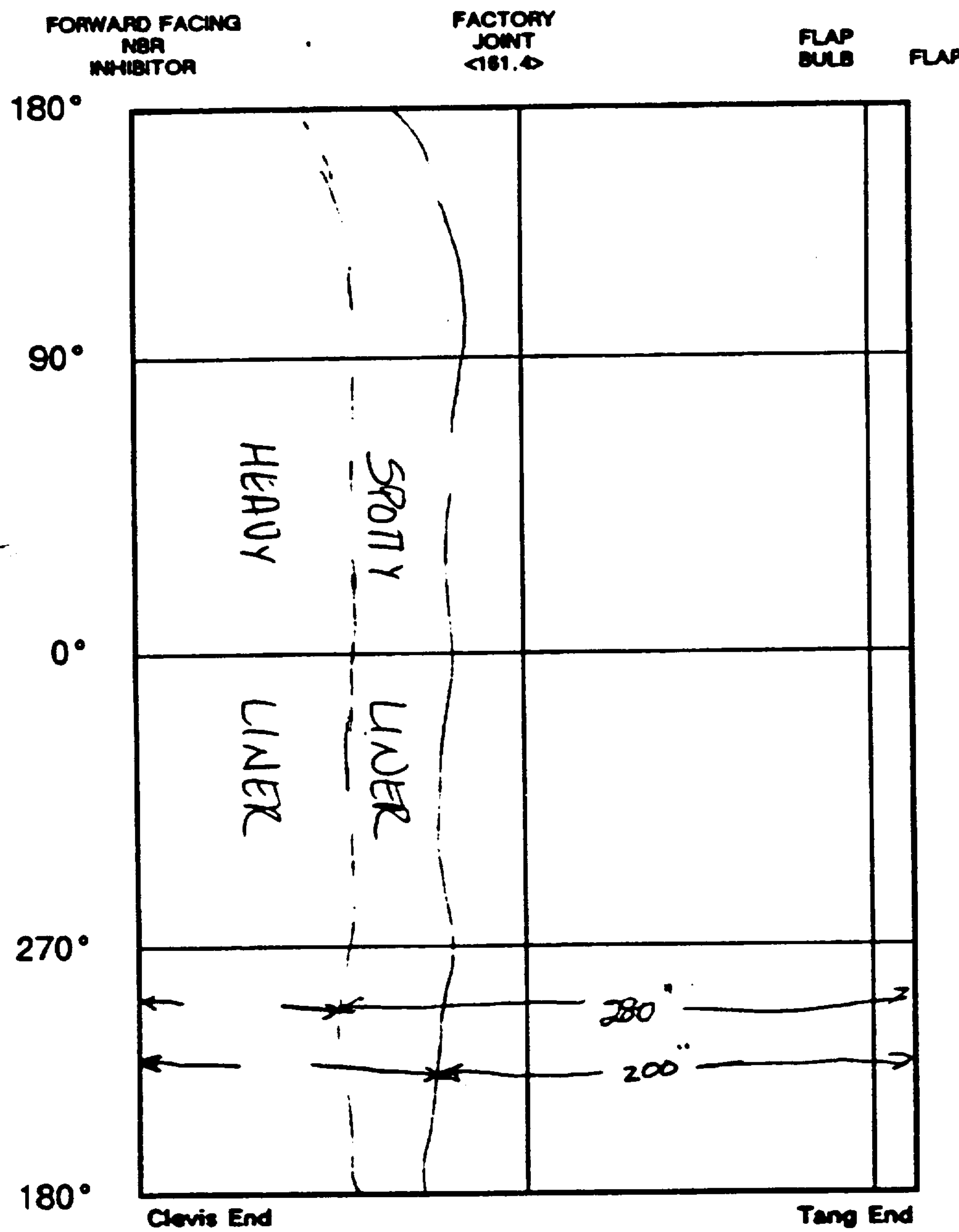
Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

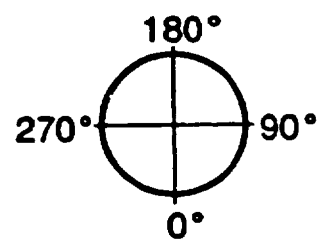
POSTFLIGHT OBSERVATION RECORD (PFOR) A-5
Aft Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8-6-92
Assessment Engineer(s)/Inspector(s): M. NEVAREZ, Reo Mackley		

Sketch Aft Center Segment Liner Pattern Observations Below:



<Location From End of Tang>



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

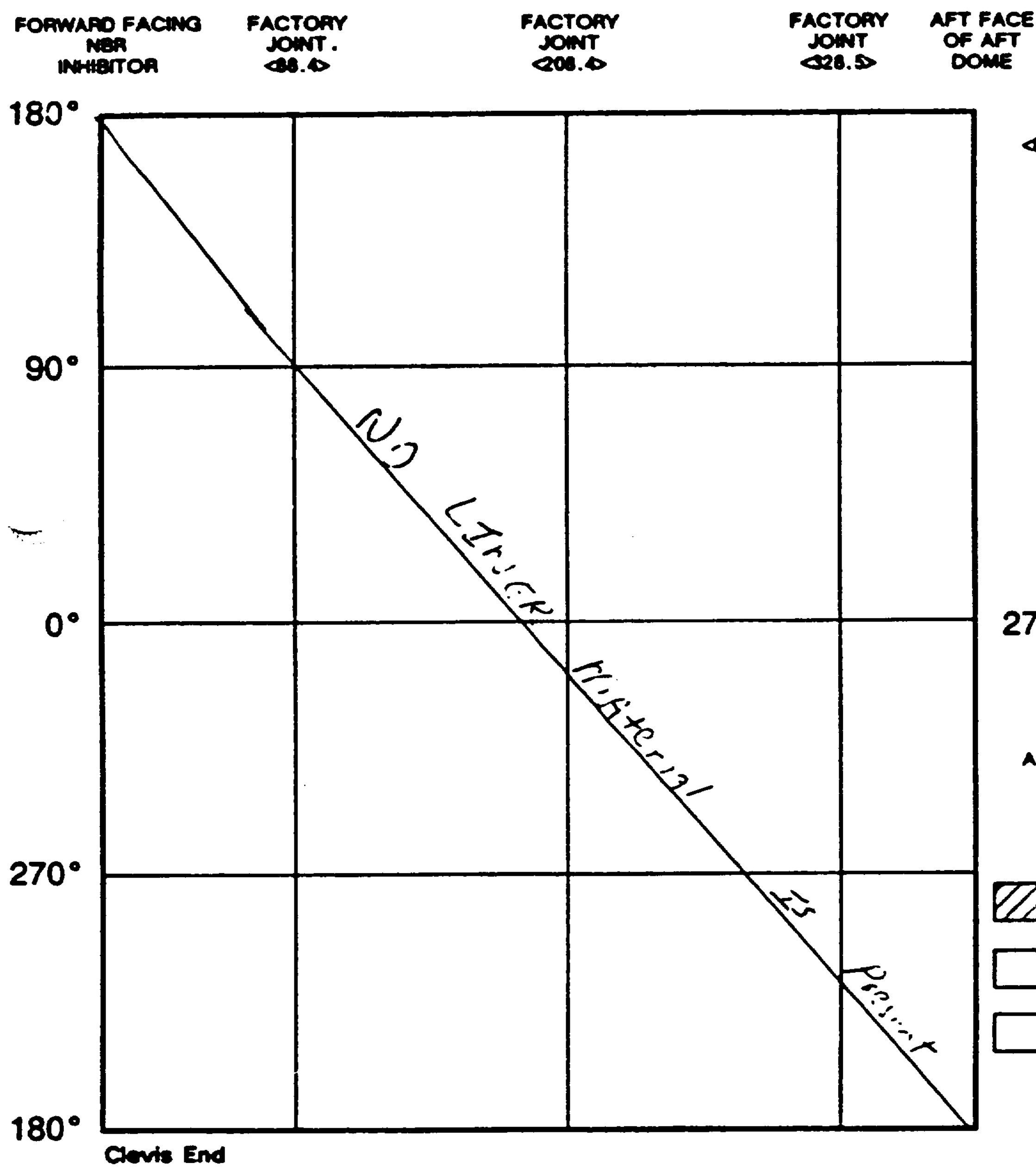
...arification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

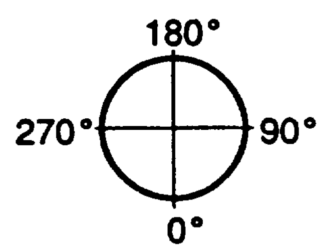
POSTFLIGHT OBSERVATION RECORD (PFOR) A-6
Aft Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 05 21 92
Assessment Engineer(s)/Inspector(s): Carnell Johnson		

Sketch Aft Segment Liner Pattern Observations Below:



<Location From End of Clevis>



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

Clarification Form(s)? _____ Yes ✓ No   Clarification Form Page No.(s): _____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-1
Postfire Insulation Common Planning Index (CPI) Log Numbers

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 6 Oct 1992

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen

Record CPI Log and Postfire Part and Serial Numbers Below:

	P/N	PPC No.	Serial No.	CPI Log No.
A. Igniter Chamber	1U75163-01	(907)	0000025	RG190
B. Igniter Adapter	1U50278-12	(902)	1	RA629
C. Forward Segment	1U76790-05	(904)	0000006	4CFIF
D. Forward Center Segment	1U76791-01	(903)	0000012	4CFJV
E. Aft Center Segment	1U76791-01	(903)	0000014	4CFJV
F. Aft Segment	1U76957-03	(904)	0000006	4CFIB

.es / Comments

1 Serial number for RSRM-21B Igniter Adapter washout has not yet been assigned.

Clarification Form(s)? ____ Yes X No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 12 June 1992
Assessment Engineer(s)/Inspector(s): Rex Mackley		
Segment: Forward		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		✓	
H. Liner Completely Missing? (Center Segments Only)		N/A	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		N/A	

Notes / Comments

...liminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Clarification Form Page No.(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 6/23/92
Assessment Engineer(s)/Inspector(s): Reo Maxley		
Segment: Forward Center		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		N/A	
H. Liner Completely Missing? (Center Segments Only)			
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		N/A	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8/14/92
Assessment Engineer(s)/Inspector(s): Rex Mackley		
Segment: Aft Center		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		NA	
H. Liner Completely Missing? (Center Segments Only)		✓	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		NA	

Notes / Comments

...liminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

...arification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-2
Segment Internal Insulation Condition (After Low Pressure Rinse)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: May 27, 1992
Assessment Engineer(s)/Inspector(s): Rex Mackley		
Segment: Aft		

Segment Internal Insulation Observations:	Yes	No	Comment #
A. Abnormal Erosion?		✓	
B. Gas Paths?		✓	
C. Ply Separations?		✓	
D. Abnormal Blisters?		✓	
E. Abnormal Cuts or Gouges?		✓	
F. Foreign Material Within Insulation?		✓	
G. Non-Uniformities in the Eleven Point Burn-out Pattern? (Forward Segment Only)		N/A	
H. Liner Completely Missing? (Center Segments Only)		N/A	
I. NBR Under the CF/EPDM Exposed in the Aft Dome?		✓	

Notes / Comments

~~Special Issue~~ 3.1.1.1 N/A Profiles were not req'd on "B" side

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) A-8

Igniter Nozzle Insert Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T021 (STS-45)	**Side:** Right (B)	**Date:** JULY 1992

Assessment Engineer(s)/Inspector(s): BRYAN BAUGH

Record the Igniter Nozzle Insert Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	6.448
60	6.436
120	6.429

Notes / Comments

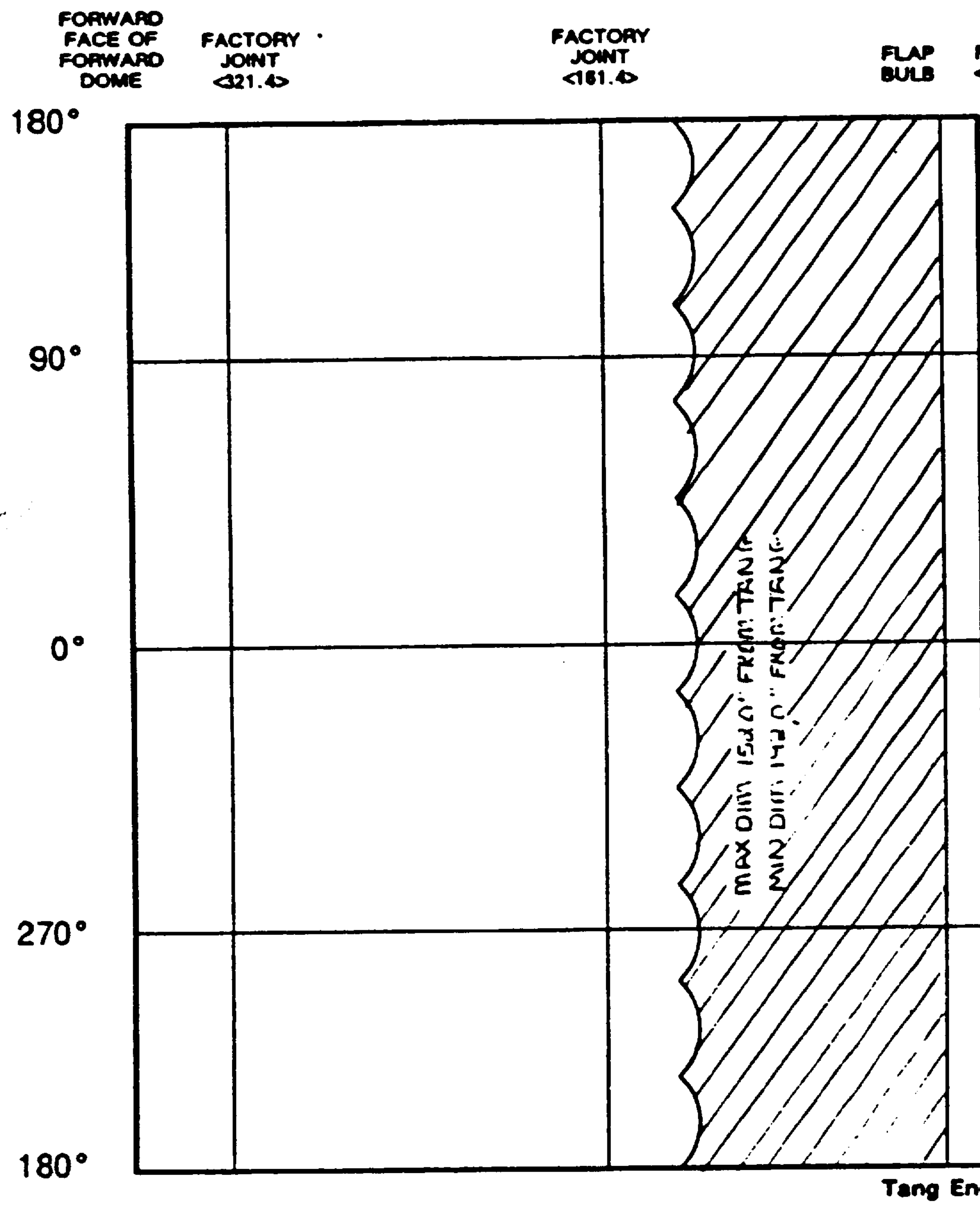
Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

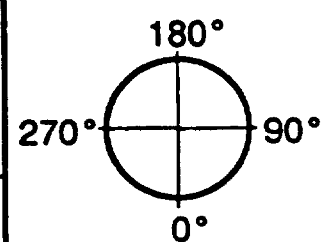
POSTFLIGHT OBSERVATION RECORD (PFOR) A-3

Forward Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 06-12-92
Assessment Engineer(s)/Inspector(s): Scott Spencer		

Sketch Forward Segment Liner Pattern Observations Below:





AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

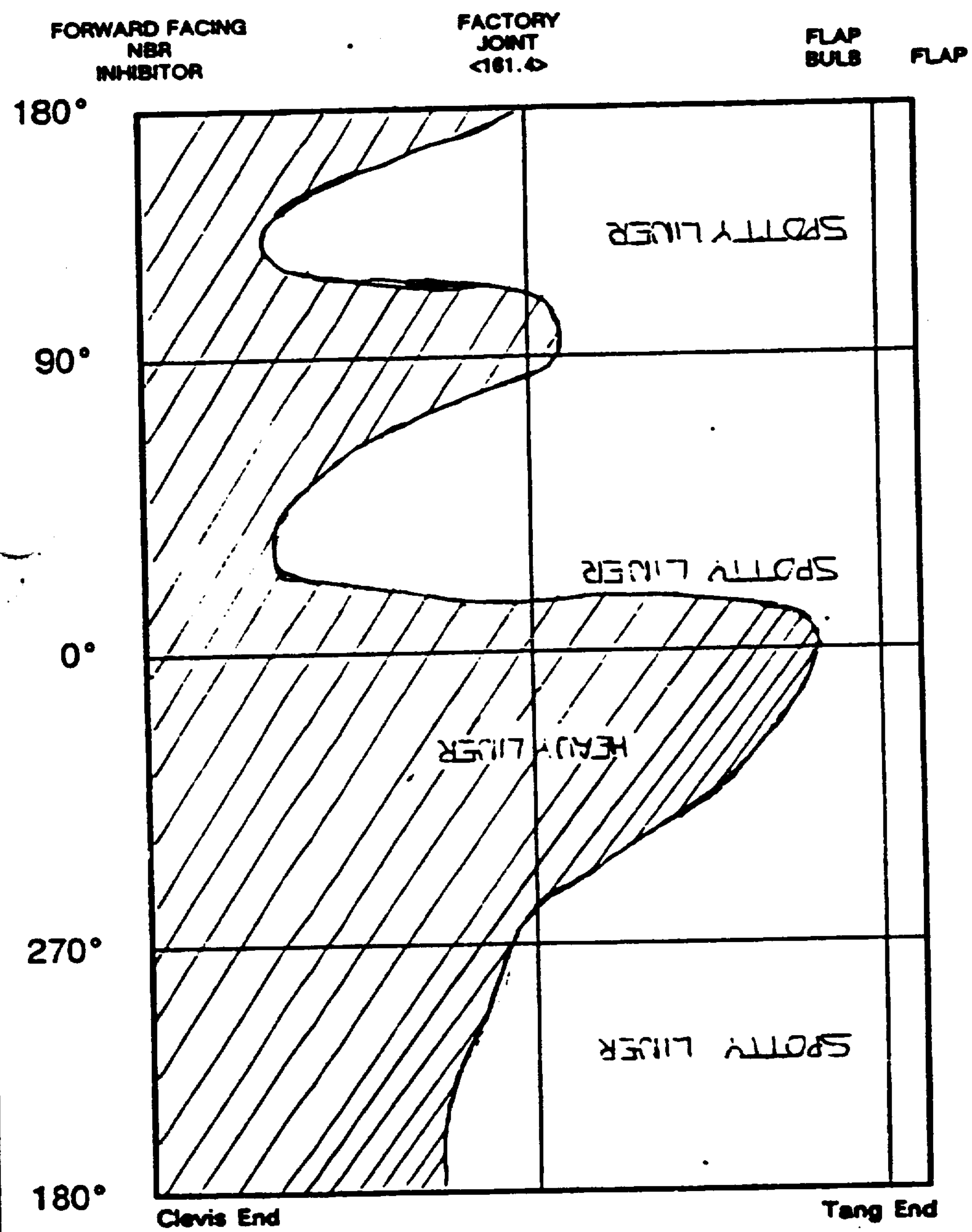
Clarification Form(s)? _____ Yes ✓ No   Clarification Form Page No.(s): __________

Thiokol CORPORATION
SPACE OPERATIONS

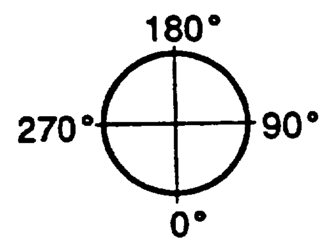
POSTFLIGHT OBSERVATION RECORD (PFOR) A-4
Forward Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 6-19-92
Assessment Engineer(s)/Inspector(s): SCOTT SPENCER		

Sketch Forward Center Segment Liner Pattern Observations Below:



<Location From End of Tang>



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

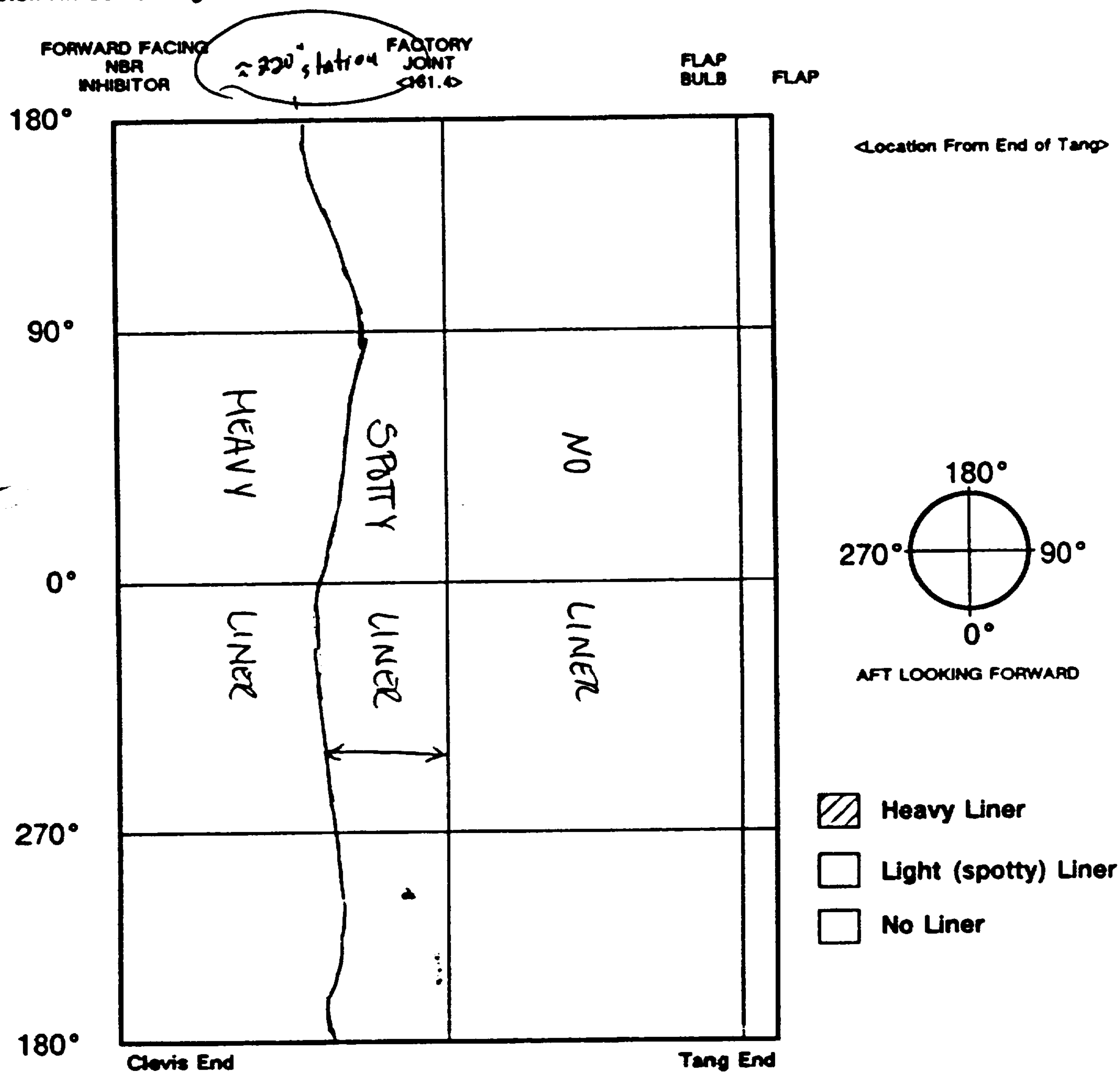
Clarification Form(s)? ______ Yes ___✓___ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-5
Aft Center Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8-24-92
Assessment Engineer(s)/Inspector(s): M. NEVAREZ		

Sketch Aft Center Segment Liner Pattern Observations Below:



Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

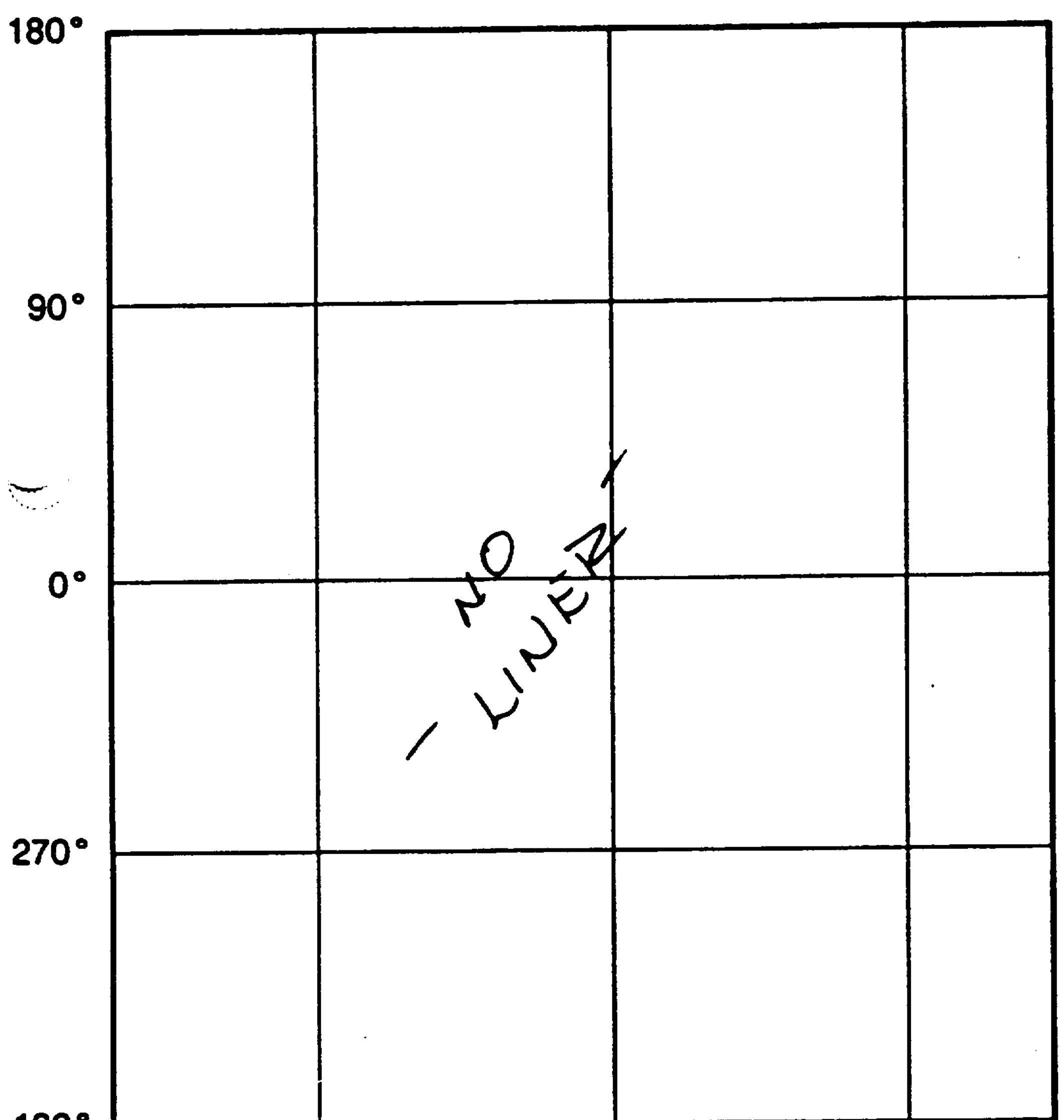
POSTFLIGHT OBSERVATION RECORD (PFOR) A-6
Aft Segment Liner Pattern (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 5-27-92
Assessment Engineer(s)/Inspector(s): B. MICHAELSON		

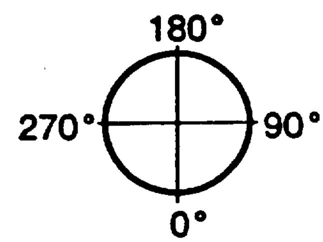
Sketch Aft Segment Liner Pattern Observations Below:

FORWARD FACING NBR INHIBITOR	FACTORY JOINT <88.4>	FACTORY JOINT <208.4>	FACTORY JOINT <328.5>	AFT FACE OF AFT DOME

<Location From End of Clevis>



Clevis End



AFT LOOKING FORWARD

- Heavy Liner
- Light (spotty) Liner
- No Liner

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): N/A

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 28 Sep 92

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen, Jim Passman

Segment: Forward Center

Sample Location: Forward Center Factory Joint

Degree Location: 0

Internal Insulation Sample Observations:	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	**Side:** Right (B)	**Date:** 28 Sep 92

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen, Jim Passman

Segment: Forward Center

Sample Location: Forward Center Factory Joint

Degree Location: 120

Internal Insulation Sample Observations:	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (Including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ____ Yes X No **Preliminary PFAR Number(s):** ________

Clarification Form(s)? ____ Yes X No **Clarification Form Page No.(s):** ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 28 Sep 92

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen, Jim Passman

Segment: Forward Center

Sample Location: Forward Center Factory Joint

Degree Location: 240

Internal Insulation Sample Observations:	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (Including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 28 Sep 92

Assessment Engineer(s)/Inspector(s): Jim Passman, Kevin Albrechtsen

Segment: Forward Center

Sample Location: Flap/Flap Bulb Region

Degree Location: 0

Internal Insulation Sample Observations:	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (Including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	**Side:** Right (B)	**Date:** 28 Sep 92

Assessment Engineer(s)/Inspector(s): Jim Passman, Kevin Albrechtsen

Segment: Forward Center

Sample Location: Flap/Flap Bulb Region

Degree Location: 120

Internal Insulation Sample Observations:	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	**Side:** Right (B)	**Date:** 28 Sep 92

Assessment Engineer(s)/Inspector(s): Jim Passman, Kevin Albrechtsen

Segment: Forward Center

Sample Location: Flap/Flap Bulb Region

Degree Location: 240

Internal Insulation Sample Observations:

	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (Including the flap terminus region)		✓	

Notes / Comments

NO VOIDS NOTED

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) A-7
Acreage and Joint Internal Insulation Sample Condition

Motor No.: 360T021 (STS-45)	Side: A	Date: 28 Sep 92

Assessment Engineer(s)/Inspector(s): Kevin Albrechtsen

Segment: CENTER FORWARD

Sample Location: .85 IN FWD OF TANG

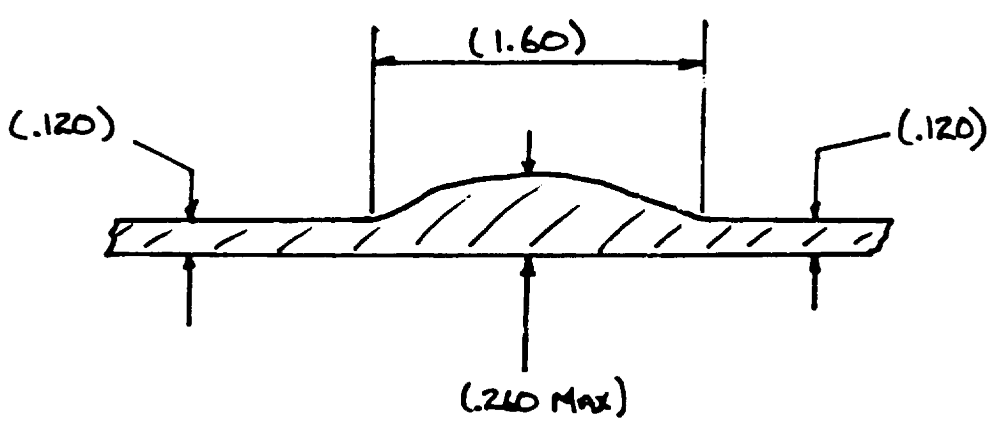
Degree Location: 90 DEG.

Internal Insulation Sample Observations:

	Yes	No	Comment #
A. Gas Paths?		✓	
B. Voids?		✓	
C. Insulation-to-Case Unbonds?		✓	
D. Ply Separations?		✓	
E. Tears? (Including the flap terminus region)		✓	

Notes / Comments

A "ridge" was present in the insulation acreage during post-flight inspection at KSC. A sample was removed per AO 4C6-59. The "ridge" appeared to be extra thick insulation in this region. A typical cross-section is shown below:



Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Clarification Form Page No.(s): ____

TWR-60695

Appendix B
Case, Seals and Joints PFORs

Final Postflight Hardware Evaluation Report 360T021 (RSRM-21, STS-45)

October 1992

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4764

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

CASE, SEALS, AND JOINTS REQUIRED PFOR LIST

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-2	S&A Device (Barrier-Booster and Environmental Seal Region) Condition	Left	S&A	B-1
B-7	S&A Rotor Shaft O-ring Condition (Detailed)	Left	S&A	B-2
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	S&A 126°	B-3
B-4	Leak Check Plug/SII Condition (Detailed)	Left	S&A 126°	B-4
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	S&A 126°	B-5
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	S&A 306°	B-6
B-4	Leak Check Plug/SII Condition (Detailed)	Left	S&A 306°	B-7
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	S&A 306°	B-8
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	18° SII	B-9
B-4	Leak Check Plug/SII Condition (Detailed)	Left	18° SII	B-10
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	18° SII	B-11
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	198° SII	B-12
B-4	Leak Check Plug/SII Condition (Detailed)	Left	198° SII	B-13
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	198° SII	B-14

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #2	B-15
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #2	B-16
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #2	B-17
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #2	B-18
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #2	B-19
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #3	B-20
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #3	B-21
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #3	B-22
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #3	B-23
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #3	B-24
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #4	B-25
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #4	B-26
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #4	B-27
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #4	B-28
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #4	B-29

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-3	Internal Nozzle Joint Condition	Left	Nozzle Joint #5	B-30
B-5	Large Diameter (Joint) O-ring Condition (Detailed)	Left	Nozzle Joint #5	B-31
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Left	Nozzle Joint #5	B-32
B-4	Leak Check Plug/SII Condition (Detailed)	Left	Nozzle Joint #5	B-33
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Left	Nozzle Joint #5	B-34
B-8	Packing With Retainer Condition (Detailed)	Left	Nozzle Fixed Housing	B-35
B-9	Case Factory Joint Condition	Left	Forward Dome	B-36
B-9	Case Factory Joint Condition	Left	Forward	B-37
B-9	Case Factory Joint Condition	Left	Forward Center	B-38
B-9	Case Factory Joint Condition	Left	Aft Center	B-39
B-9	Case Factory Joint Condition	Left	ET Attach/ Stiffener	B-40
B-9	Case Factory Joint Condition	Left	Stiffener/ Stiffener	B-41
B-9	Case Factory Joint Condition	Left	Aft Dome	B-42

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

PFOR #	Title	Side	Joint or Location	Final Report Page Number
B-2	S&A Device (Barrier-Booster and Environmental Seal Region) Condition	Right	S&A	B-43
B-7	S&A Rotor Shaft O-ring Condition (Detailed)	Right	S&A	B-44
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	S&A 126°	B-45
B-4	Leak Check Plug/SII Condition (Detailed)	Right	S&A 126°	B-46
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	S&A 126°	B-47
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	S&A 306°	B-48
B-4	Leak Check Plug/SII Condition (Detailed)	Right	S&A 306°	B-49
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	S&A 306°	B-50
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	18° SII	B-51
B-4	Leak Check Plug/SII Condition (Detailed)	Right	18° SII	B-52
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	18° SII	B-53
B-1	Leak Check Plug/SII and Port Condition (At Removal)	Right	198° SII	B-54
B-4	Leak Check Plug/SII Condition (Detailed)	Right	198° SII	B-55
B-6	Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	198° SII	B-56

(Note: Clarification forms will be inserted after the required PFOR in the Final Report. The clarification form page number will be the same as the required PFOR Final Report page number appended by a sequential alphabetic extension.)

CASE, SEALS, AND JOINTS REQUIRED LIST (Cont.)

Title	Side	Joint or Location	Final Report Page Number
Internal Nozzle Joint Condition	Right	Nozzle Joint #2	B–57
Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #2	B–58
Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #2	B–59
Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #2	B–60
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #2	B–61
Internal Nozzle Joint Condition	Right	Nozzle Joint #3	B–62
I[illegible]e Diameter (Joint) O-ring Condition ([illegible]iled)	Right	Nozzle Joint #3	B–63
Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #3	B–64
Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #3	B–65
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #3	B–66
Internal Nozzle Joint Condition	Right	Nozzle Joint #4	B–67
Large Diameter (Joint) O-ring Condition (Detailed)	Right	Nozzle Joint #4	B–68
Leak Check Plug/SII and Port Condition (At Removal)	Right	Nozzle Joint #4	B–69
Leak Check Plug/SII Condition (Detailed)	Right	Nozzle Joint #4	B–70
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)	Right	Nozzle Joint #4	B–71

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Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-2
S&A Device (Barrier-Booster and Environmental Seal Regions) Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Barrier-Booster Bore and Rotor Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring (In Groove)?		✓	
B. Soot To or Past O-rings?	✓		1
C. Heat Affected Metal?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Metal Damage?		✓	
F. Excessive or No Grease?		✓	
G. Corrosion?	✓		2
H. Foreign Material?	✓		3 & 4 & 6
I. Teflon Retainer Damage?		✓	
Environmental Seal Region Observations:			
J. Environmental O-ring Assembly Damage (Visible Without Magnification)?		✓	
K. Foreign Material?		✓	5

Notes / Comments

1) Soot upto the primary seal but not past.
2) The rotor shaft spring had corrosion on its entire surface. Photo #s (128129-4 & -10). Preliminary PFAR was written.
3) Foreign Material on the secondary seals, entire circumference appear to be copper flakes and green scotch brite. (Photo #s 128129-6 & -7) Preliminary PFAR was written.
4) Foreign Material in the ullage cavity region. (Photo #s 128129-8 & -9) appears to be green scotch brite. Preliminary PFAR was written.
5) Foreign Material at 2 locations at the bolt hole region, appears to be nylok. (Photo #s 128130 - 2 & -3)

Preliminary PFAR(s)? ✓ Yes ___ No   Preliminary PFAR Number(s): 45C-11, 12 & 13

Clarification Form(s)? ___ Yes ✓ No   Clarification Form Page No.(s): ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-7
S&A Rotor Shaft O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: S&A Device Barrier-Booster Rotor Shaft		

	Yes	No	Comment #
Forward Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Aft Primary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	
Forward Secondary O-ring Observations:			
E. Heat Affected or Eroded O-ring?		✓	
F. O-ring Defects/Damage?		✓	
t Secondary O-ring Observations:			
G. Heat Affected or Eroded O-ring?		✓	
H. O-ring Defects/Damage?		✓	

Notes / Comments

reliminary PFAR(s)? ____ Yes ✓ No　　Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No　　Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sll and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 126-Degree Barrier-Booster Bore

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No. (s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 126-Degree Barrier-Booster Bore

<u>Leak Check Plug Observations:</u>	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

…liminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6

Small Diameter (Leak Check Plug/Sil) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. Mac Cauley, B. Selby, M. Lyon

Location: 126-Degree Barrier-Booster Bore

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

liminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. Mac Cauley, B. Selby, M. Lyon

Location: 306-Degree Barrier-Booster Flange

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

...liminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

...larification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 306-Degree Barrier-Booster Flange

Leak Check Plug Observations:

	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

'iminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Clarification Form Page No.(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. Mac Cauley, B. Selby, M. Lyon

Location: 306-Degree Barrier-Booster Flange

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: 18-Degree Sil		

Sil Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Sil?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Sil Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

eliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 18-Degree SII

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

...liminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 18-Degree SII

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

...liminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

...arification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, R. Selby, M. Lyon		
Location: 198-Degree SII		

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

eliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

larification Form(s)? ______ Yes ✓ No   Clarification Form Page No. (s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992

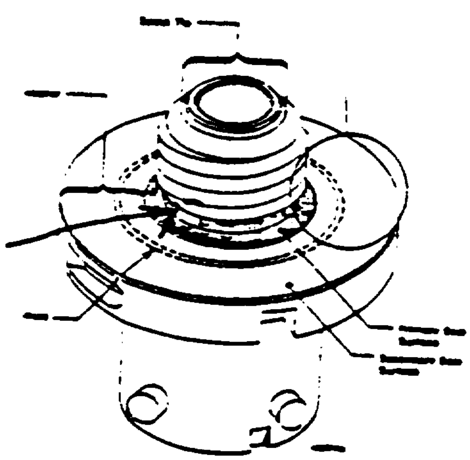
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCawley, B. Selby, M. Lyon

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?	✓		1

Notes / Comments

1) Thread damage on last 2 threads, ..
Damage is not outside of the thread region and no raised metal was found.
Preliminary PFAR was written.
Photo number: 128129-2



Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 45C-14

Clarification Form(s)? ___ Yes ✓ No Clarification Form Page No.(s): ___

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: 198-Degree SII		

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45) | **Side:** Left (A) | **Date:** 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, L Wilkes, C. Walker, L. MacCauley

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?	X		#1
B. Heat Affected Metal?		X	
C. Foreign Material?		X	
D. RTV in Contact With or Past the Primary O-ring?		X	
E. O-ring Damage (In Groove)?		X	#3
F. Heat Affected or Eroded O-rings (In Groove)?		X	
G. Excessive or No Grease?		X	
H. Corrosion?	X		#2
I. Metal Damage?		X	

Notes / Comments

#1. Soot to primary O-ring between bolt holes, intermittently, full circumference.

#2. Light to medium corrosion and paint chips intermittently, full circumference on OD tip of fwd end ring.

#3. Primary O-ring fell completely out of groove at disassembly.

Preliminary PFAR(s)? ____ Yes __X__ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? __X__ Yes ____ No   Clarification Form Page No.(s): B-15A

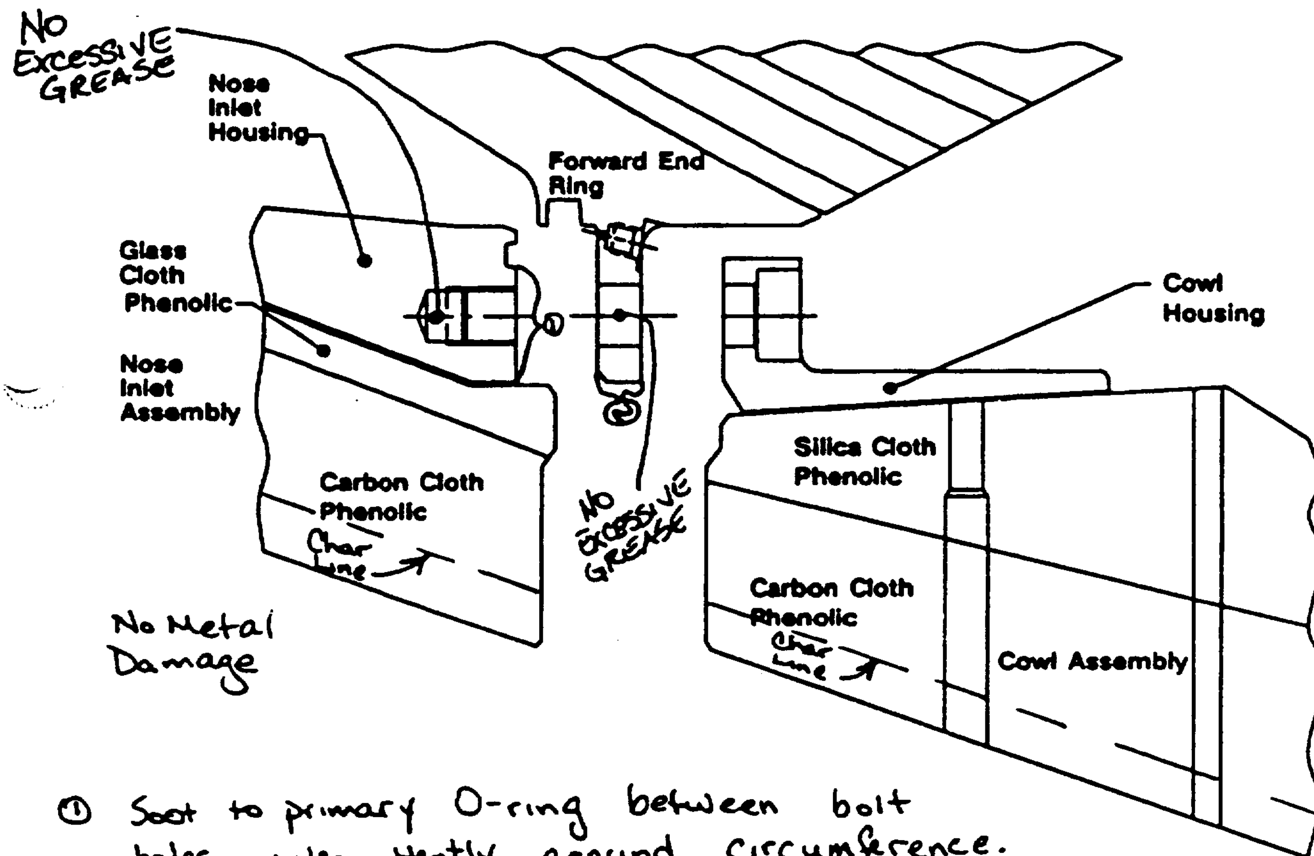
Thiokol CORPORATION
SPACE OPERATIONS

Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☒ Left (A) ☐ Right (B)	Date: 9 April 92
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, C. Walker, L. MacCauley		

Sketch Observations Below (include locations and sizes of sketched features):

- Typical jack screw marks on Nose Inlet Housing flange
- Light-to-medium corrosion on bearing forward end ring forward I.D. flange interface at 3 yack screw holes.



① Soot to primary O-ring between bolt holes intermittently around circumference.

② Light-to-medium corrosion and paint chips intermittently, full circumference.

Corresponding Comment Number(s): #1, #2

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

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Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45) | **Side:** Left (A) | **Date:** 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		X	
B. Soot To or Past O-ring?		X	
C. Foreign Material?		X	
D. O-ring Damage (In Groove)?		X	
E. Heat Affected or Eroded O-ring (In Groove)?		X	
F. Excessive or No Grease on O-ring?		X	
G. Excessive Grease on Plug?		X	
H. Corrosion?		X	
I. Thread Damage (Visible at Removal)?		X	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		X	
K. Foreign Material?		X	
L. Excessive Grease?		X	
M. Corrosion?		X	
N. Metal Damage?		X	
O. Heat Affected Metal?		X	
P. Obstructed Through Hole?		X	

Notes / Comments

NOTE: Leak Check Port:
Breaking Torque = 32 in-lb
Running Torque = 4 in-lb

Preliminary PFAR(s)? ____ Yes __X__ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes __X__ No   Clarification Form Page No.(s): ________

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		X	
B. Heat Affected Metal?		X	
C. Seal Surface/Thread Damage?		X	

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Chec', Plug/Sil) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Defects/Damage?		X	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 8 April 92
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, C. Walker, L. MacCauley		
Joint: Nose Inlet-to-Throat (Joint #3)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		X	
B. Heat Affected Metal?		X	
C. Foreign Material?		X	
D. RTV in Contact With or Past the Primary O-ring?		X	#4
E. O-ring Damage (In Groove)?		X	
F. Heat Affected or Eroded O-rings (In Groove)?		X	
G. Excessive or No Grease?		X	#1
H. Corrosion?	X		#2
I. Metal Damage?		X	#3

Notes / Comments

Special Issue 3.2.3.2

Special Issue concerns defects on the O-ring mating seal surface on the throat housing. No defects or metal damage was observed on sealing surface.

Comments #1 – #4, see clarification form, B-20A.

liminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

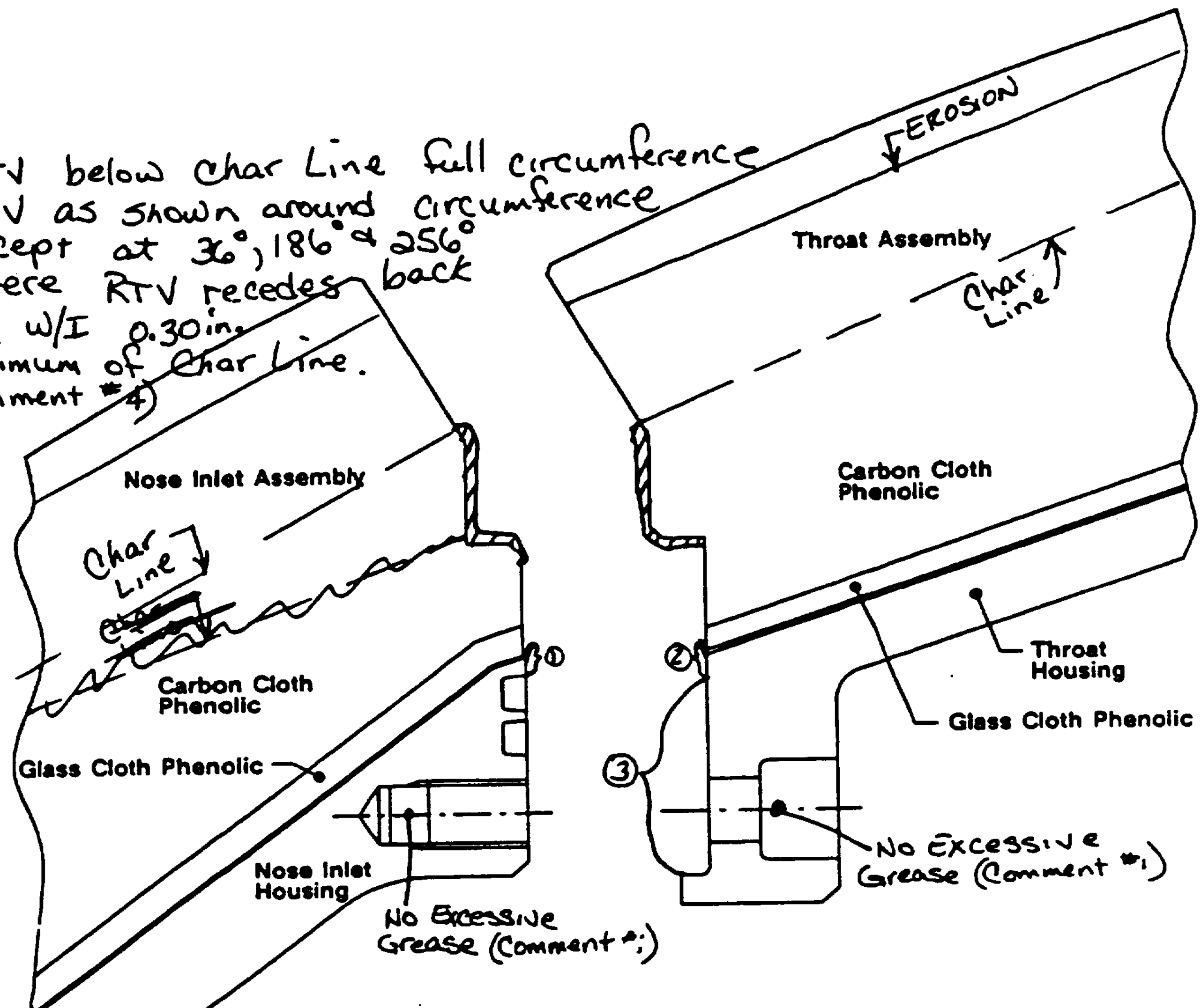
Clarification Form(s)? X Yes ____ No Clarification Form Page No.(s): B-20A

Thiokol CORPORATION
SPACE OPERATIONS

Nose Inlet-to-Throat Joint (Joint #3) Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☒ Left (A) ☐ Right (B)	Date: 8 April 92
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, C. Walker, L. MacCauley		

Sketch Observations Below (include locations and sizes of sketched features):



1. Typical Aluminum Oxide corrosion Light to-medium (Comment #2). intermittently, full circumference.
2. Light corrosion at metal/adhesive interface (comment #2).
3. Good grease coverage with no corrosion on metal damage or metal defects (Special Issue 3.2.3.2) (Comments #2 & #3).

Corresponding Comment Number(s): #1, #2, #3, #4

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8 April 92
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, C. Walker, L. MacCauley		
Joint: Nose Inlet-to-Throat (Joint #3)		

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	

Notes / Comments

Preliminary PFAR(s)? ____ Yes __X__ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, C. Walker, L. MacCauley

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		X	
B. Soot To or Past O-ring?		X	
C. Foreign Material?		X	
D. O-ring Damage (In Groove)?		X	
E. Heat Affected or Eroded O-ring (In Groove)?		X	
F. Excessive or No Grease on O-ring?		X	
G. Excessive Grease on Plug?		X	
H. Corrosion?		X	
I. Thread Damage (Visible at Removal)?		X	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		X	
K. Foreign Material?		X	
L. Excessive Grease?		X	
M. Corrosion?		X	
N. Metal Damage?		X	
O. Heat Affected Metal?		X	
P. Obstructed Through Hole?		X	

Notes / Comments

Leak check port plug:
Breaking torque = 49 in-lb.
Running torque = 20 in-lb.

Preliminary PFAR(s)? ____ Yes X No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No   Clarification Form Page No. (s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 8 April 92

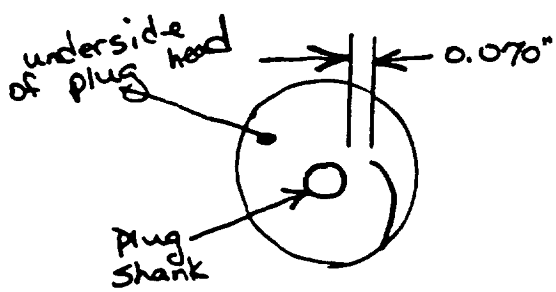
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, L. MacCauley, C. Walker

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		X	
B. Heat Affected Metal?		X	
C. Seal Surface/Thread Damage?	X		#1

Notes / Comments

#1. Scratch running diagonally on bottom side of plug head. Scratch could be felt using the brass shim stock test. Scratch is approximately 0.200 inch in length, starts at ≈ 0.070 inch radially from plug shank and goes to outside edge. (See PFAR 45C-07)



Preliminary PFAR(s)? X Yes ___ No **Preliminary PFAR Number(s):** 45C-07

Clarification Form(s)? ___ Yes X No **Clarification Form Page No.(s):** ______

REVISION ___

DOC NO. TWR-60695 | VOL
SEC | PAGE B-23

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, C. Walker, L. Wilkes, L. MacCauley

Location: Nose Inlet-to-Throat (Joint #3)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Defects/Damage?		X	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Joint: Throat-to-Forward Exit Cone (Joint #4)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?	✓		3

Notes / Comments

Special Issue 3.2.3.2

1. RTV to the primary O-ring full circumference except for the region 267.5-277.5°.
2. Typical light-medium corrosion between the primary and secondary O-rings intermittently full circumference. Heavy corrosion and pitting on the primary sealing surface of the throat housing at the following locations: 0-10°, 17.5-30°, 45°, 70-75°, 87.5-115°, 145-175°, 205°, 260-280°, 295°, 340-0°. Photos were taken at two locations:
A preliminary PFAR was written on the heavy corrosion. (45C-02)
Heavy corrosion and pitting on the secondary sealing surface of the forward exit cone at 25-37.5° and 190°. Photos were taken at two locations: 127987-1 and 127987-2. A preliminary PFAR was written on the heavy corrosion on the secondary O-ring sealing surface. (45C-03)
3. Scratch between primary and secondary on forward exit cone at 152°. Could be felt with a 5 mil shim. The scratch was not on a seal surface.

Special issue 3.2.3.2: The throat support housing seal zones were evaluated with the extended seal zone criteria. The previous observations take this seal zone into account.

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 45C-02, 45C-03

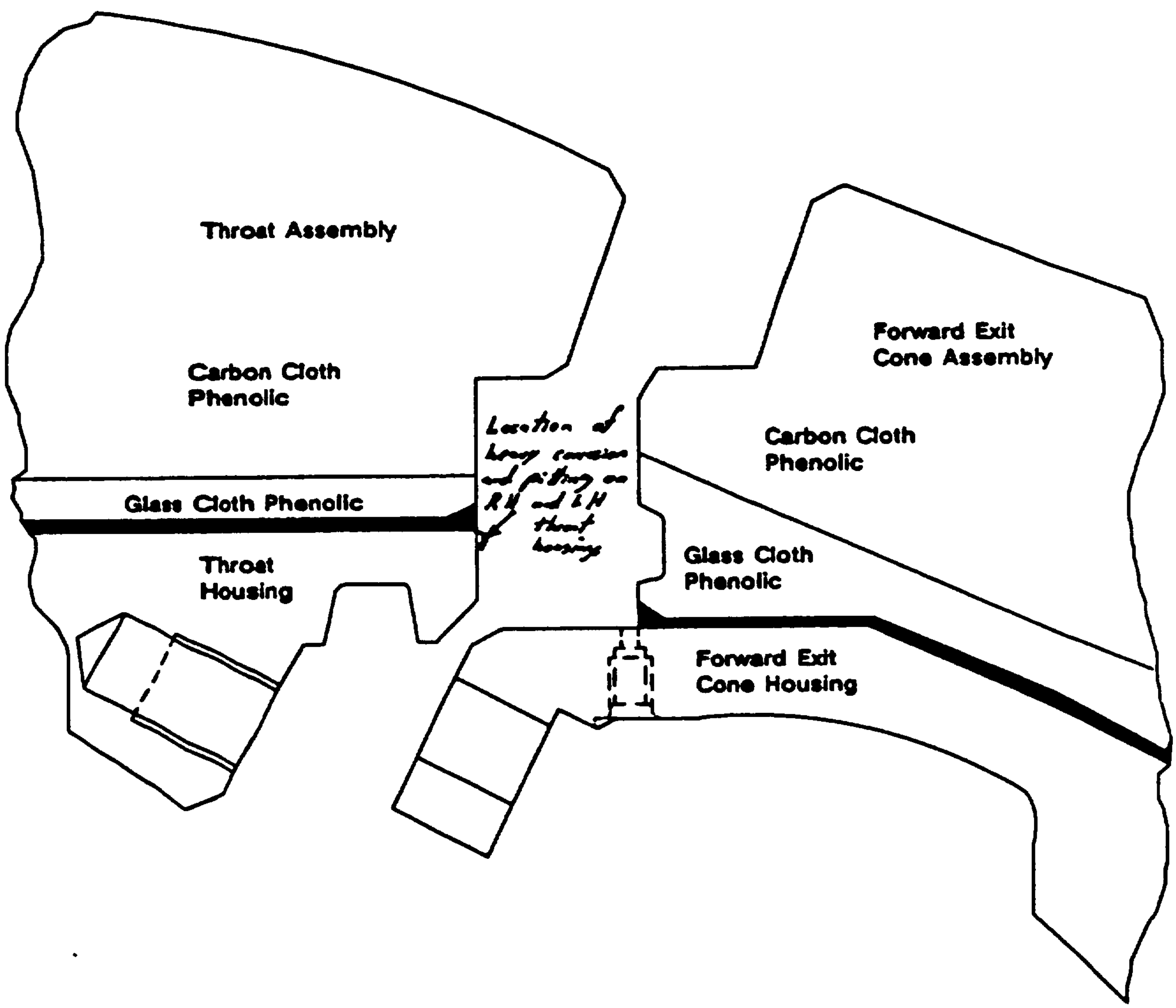
Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): B-25A

Thiokol CORPORATION
SPACE OPERATIONS

Throat-to-Forward Exit Cone Joint (Joint #4) Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☒ Left (A) ☒ Right (B)	Date: 4/7/92
Assessment Engineer(s)/Inspector(s): Art Merrit		

Sketch Observations Below (include locations and sizes of sketched features):



Corresponding Comment Number(s): 2

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt, Marvin Lynn

Joint: Throat-to-Forward Exit Cone (Joint #4)

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No   Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No   Clarification Form Page No.(s): _____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merrit

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Break torque: 38 in-lbs
Running torque: 14 in-lbs

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Break torque: 38 in-lbs
Running torque: 14 in-lbs

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merriott

Location: Throat-to-Forward Exit Cone (Joint #4)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION

SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3

Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?	✓		1
D. RTV in Contact With or Past the Primary O-ring?	✓		3
E. O-ring Damage (in Groove)?		✓	
F. Heat Affected or Eroded O-rings (in Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?	✓		4

Notes / Comments

Special Issue 3.2.3.1

1. -A reddish smudge mark was seen at 352° (possibly RTV) between the primary and secondary seals. (Approx 0.5" long) A preliminary PFAR was written and pictures were taken. (#s 137989-10 & 137990-?)

-Typical water droplets were observed full circumference between the primary and secondary grooves on the bearing assembly.

-Typical Nylok in slot between the primary and secondary seals of the bearing assembly.

2. Typical light corrosion between the primary and secondary seals on both facing surfaces full circumference intermittent.
3. RTV contacted the O-ring over a one inch span at 300°. RTV did not flow past the primary O-ring.
4. The first thread of 3 bolt holes were damaged at 120, 165 and 300°.

Special Issue 3.2.3.1: The goldfleas of the fixed housing appeared in good condition, the chamfers did not appear to have any deformations that could be detected visually. (The PIR were not logged separately but were inspected as a group).

Preliminary PFAR(s)? ✓ Yes ___ No   Preliminary PFAR Number(s): 45C-04

Clarification Form(s)? ___ Yes ✓ No   Clarification Form Page No.(s): ______

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt, Marvin Lyon

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Break torque: 37.5 in-lbs
Running torque: 10 in-lbs

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merrit

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

liminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-8
Packing With Retainer Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Packing With Retainer Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Seal or Retainer?		✓	
B. Seal or Retainer Damage/Defects?	✓		1
C. Corrosion?	✓		2

Notes / Comments

Special Issue 3.2.3.1

1. 61/72 packing with retainers had seal or retainer damage due to assembly/disassembly
2. 72/72 packing with retainers had typical discoloration on the retainer.

Special Issue 3.2.2.1.3
Note: Stat-O-Seals were not individually bagged.
The spotface on the fixed housing had no rounding of the bolt holes observable. Damage to the retainers was typical and due to disassembly

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 07-17-92
Assessment Engineer(s)/Inspector(s): ERic HAY		
Factory Joint: Forward Dome		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 07-17-92
Assessment Engineer(s)/Inspector(s): ERIC HAY		
Factory Joint: Forward		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments
NONE

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 07-17-92

Assessment Engineer(s)/Inspector(s): ERIC HAY

Factory Joint: Forward Center

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 09-18-92
Assessment Engineer(s)/Inspector(s): ERIC HAY		
Factory Joint: Aft Center		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	#1
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

#1 PRi O-Ring has WaTER knife NIBBLing

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 6-9-92
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: ET Attach/Stiffener		

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	**Side:** Left (A)	**Date:** 9 JUN 1992

Assessment Engineer(s)/Inspector(s): Darin Birch

Factory Joint: Stiffener/Stiffener

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes __✓__ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __✓__ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 9 JUN 1992
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: Aft Dome		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-2
S&A Device (Barrier-Booster and Environmental Seal Regions) Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Barrier-Booster Bore and Rotor Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring (In Groove)?		✓	
B. Soot To or Past O-rings?	✓		1
C. Heat Affected Metal?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Metal Damage?		✓	
F. Excessive or No Grease?		✓	
G. Corrosion?		✓	
H. Foreign Material?		✓	
I. Teflon Retainer Damage?		✓	
Environmental Seal Region Observations:			
J. Environmental O-ring Assembly Damage (Visible Without Magnification)?		✓	
K. Foreign Material?		✓	2

Notes / Comments

1) Soot upto the primary seal but not past.

2) Foreign Material at 3 locations at the bolt hole region, appears to be nylok.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-7
S&A Rotor Shaft O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: S&A Device Barrier-Booster Rotor Shaft

	Yes	No	Comment #
Forward Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Aft Primary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	
Forward Secondary O-ring Observations:			
E. Heat Affected or Eroded O-ring?		✓	
F. O-ring Defects/Damage?		✓	
't Secondary O-ring Observations:			
G. Heat Affected or Eroded O-ring?		✓	
H. O-ring Defects/Damage?		✓	

Notes / Comments

reliminary PFAR(s)? _____ Yes ✓ No   Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No   Clarification Form Page No.(s): _____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: 126-Degree Barrier-Booster Bore		

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sll Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): R. Albright, L. Mac Cauley, B. Selby, M. Lyon		
Location: 126-Degree Barrier-Booster Bore		

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 126-Degree Barrier-Booster Bore

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, M. Lyon

Location: 306-Degree Barrier-Booster Flange

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

eliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 306-Degree Barrier-Booster Flange

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

...liminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, M. Lyon, B. Selby

Location: 306-Degree Barrier-Booster Flange

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sll and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon

Location: 18-Degree SII

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) 8-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: 18-Degree SII		

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992
Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, B. Selby, M. Lyon		
Location: 18-Degree SII		

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No. (s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/SII and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. Mac Cauley, B. Selby, M. Lyon

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on SII?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
SII Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Leak Check Through Hole?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/SII Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. Mac Cauley, B. Selby, M. Lyon

Location: 198-Degree SII

SII Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and SII?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 15 April 1992

Assessment Engineer(s)/Inspector(s): P. Albright, L. MacCauley, M. Lyon, B. Selby

Location: 198-Degree SII

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	
Secondary O-ring Observations:			
C. Heat Affected or Eroded O-ring?		✓	
D. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, L. MacCauley, C. Walker, A. Marriott

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?	X		#1
B. Heat Affected Metal?		X	
C. Foreign Material?	X		#2
D. RTV in Contact With or Past the Primary O-ring?		X	
E. O-ring Damage (In Groove)?		X	
F. Heat Affected or Eroded O-rings (In Groove)?		X	
G. Excessive or No Grease?		X	
H. Corrosion?		X	
I. Metal Damage?		X	

Notes / Comments

#1. Soot to primary O-ring between bolt holes
intermittently around full circumference.

#2. See general Clarification form page C-29A. PFAR
45C-06 was written on foreign material in
joint past primary O-ring on both the Nose
Inlet Housing and Forward End Ring; and on
the primary O-ring footprint. A lab analysis
concluded that the foreign material was a
burnt residue (soot) mixed with HD-2 grease and
methyl chloroform. Methy Chloroform was used to
clean the jack screw holes (one at 15°) prior
to inserting jack screws. Apparently, the jack screw
hole at 15° was saturated with M.C. flushing soot
into and past the primary O-ring groove. The threaded
bolt holes on the Nose Inlet (2 were) filled with residue
and approximately 1/2 inch of M.C. Also M.C. noted in
Nose Inlet threaded hole at 6°. . . . . . .

Preliminary PFAR(s)? X Yes ____ No Preliminary PFAR Number(s): 45C-06

Clarification Form(s)? X Yes ____ No Clarification Form Page No.(s): B-57A

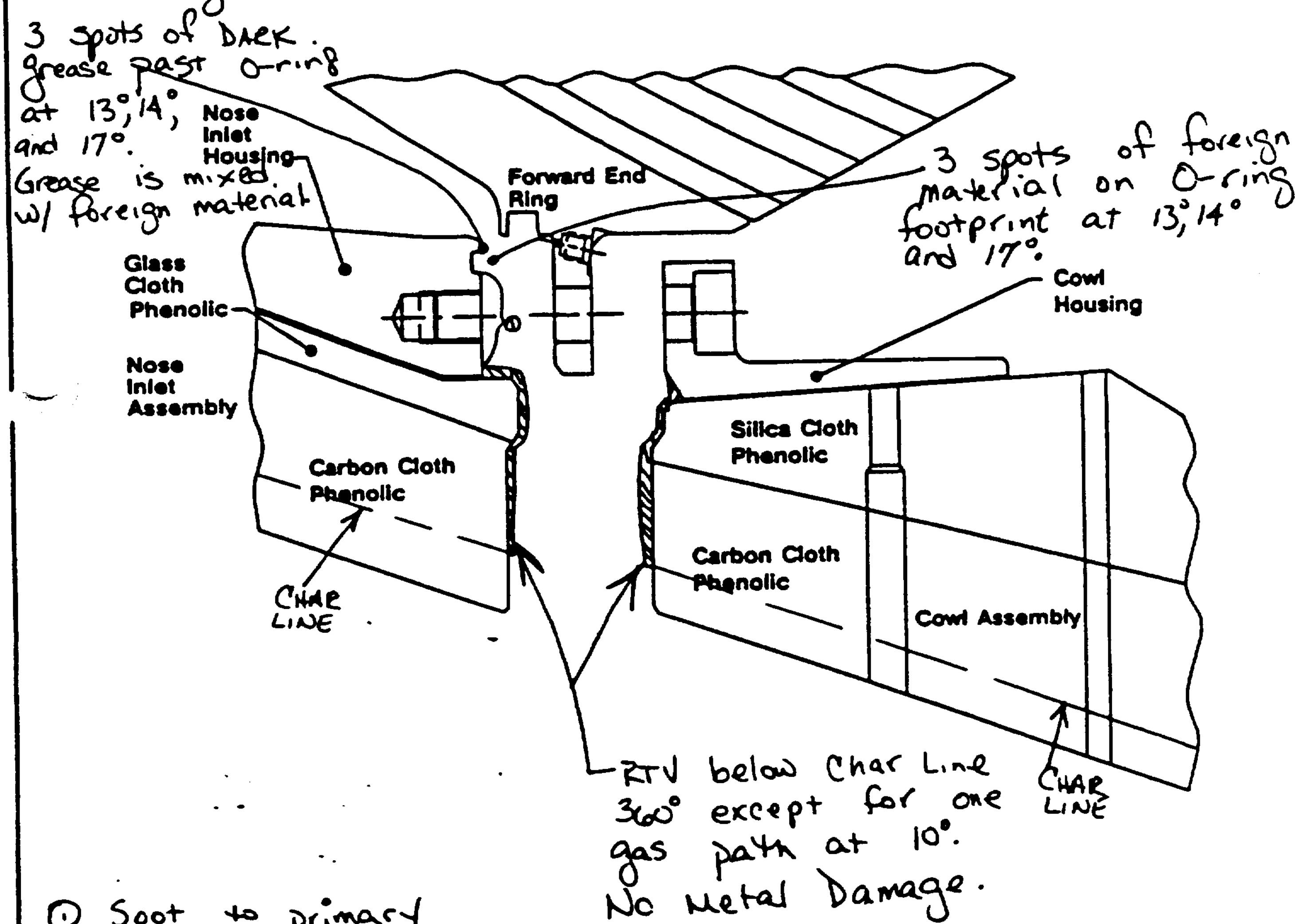
REVISION ____

Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☒ Right (B)	Date: 8 April 92
Assessment Engineer(s)/Inspector(s): T. Kerrigan, L. Wilkes, L. MacCauley, C. Walker		

Sketch Observations Below (include locations and sizes of sketched features):

- Typical jack screw scratch marks on Nose Inlet Housing
- Light to medium corrosion on bearing forward end ring forward ID flange interface at 3 jack screw holes.



① Soot to primary O-ring between bolt holes intermittently, full circumference.

Corresponding Comment Number(s): #1, #2

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, A. Marriott, M. Lyon, V. Gunther

Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Damage/Defects?		X	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, C. Walker, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		X	
B. Soot To or Past O-ring?		X	
C. Foreign Material?		X	
D. O-ring Damage (In Groove)?		X	
E. Heat Affected or Eroded O-ring (In Groove)?		X	
F. Excessive or No Grease on O-ring?		X	
G. Excessive Grease on Plug?		X	
H. Corrosion?		X	
I. Thread Damage (Visible at Removal)?		X	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		X	
K. Foreign Material?		X	
L. Excessive Grease?		X	
M. Corrosion?		X	
N. Metal Damage?		X	
O. Heat Affected Metal?		X	
P. Obstructed Through Hole?		X	

Notes / Comments

Leak Check Port Plug:
Breaking Torque = 59 in-lb. (*)
Running Torque = 7.5 in-lb.

(*) Note, upon plug removal the technician (manufacturing) thought he was de-torquing when he was actually torquing the plug. This most probably resulted in a higher breaking torque.

Preliminary PFAR(s)? ____ Yes __X__ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		X	
B. Heat Affected Metal?		X	
C. Seal Surface/Thread Damage?		X	

Notes / Comments

Preliminary PFAR(s)? _____ Yes __X__ No Preliminary PFAR Number(s): __________

Clarification Form(s)? _____ Yes __X__ No Clarification Form Page No.(s): __________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 8 April 92

Assessment Engineer(s)/Inspector(s): T. Kerrigan, M. Lyon

Location: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		X	
B. O-ring Defects/Damage?		X	

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No   Clarification Form Page No.(s): ____

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/8/92

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Lyons

Joint: Nose Inlet-to-Throat (Joint #3)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

Special Issue 3.2.3.2

1- RTV was in contact with the primary O-ring @ 135° - 143°.

2- Light intermittent corrosion inboard of the primary seal surface on the throat housing.

3. Special Issue 3.2.3.2
No anomalous conditions were found.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

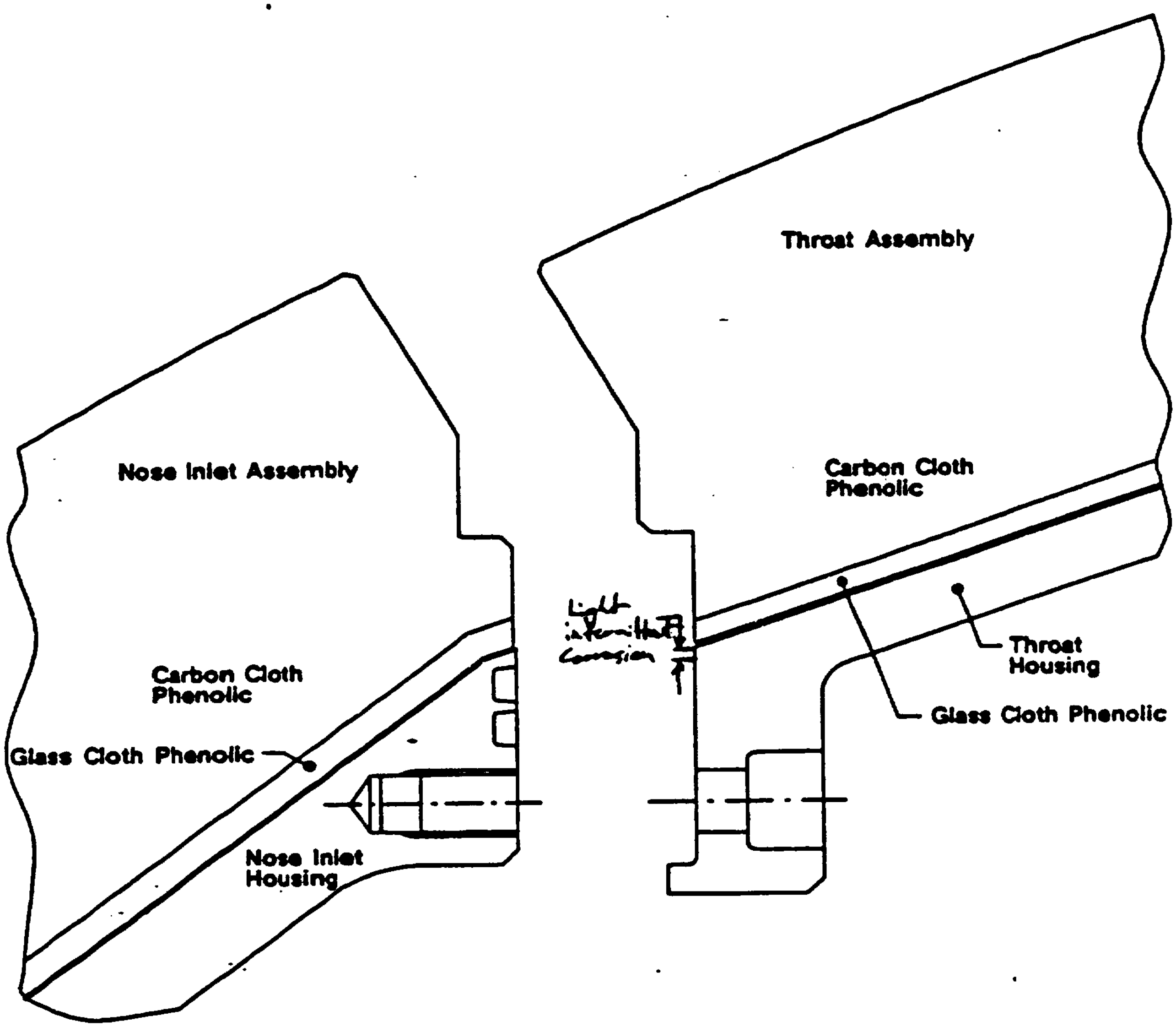
Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): B-62A

Thiokol CORPORATION
SPACE OPERATIONS

Nose Inlet-to-Throat Joint (Joint #3) Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☒ Right (B)	Date: 4/8/92
Assessment Engineer(s)/Inspector(s): W. Sperry		

Sketch Observations Below (include locations and sizes of sketched features):



Corresponding Comment Number(s): 2

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/8/92

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Lyons

Joint: Nose Inlet-to-Throat (Joint #3)

Primary O-ring Observations:	1U75150-10 0000067	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?			✓	
B. O-ring Damage/Defects?			✓	
Secondary O-ring Observations:	1U75150-09 0000064			
A. Heat Affected or Eroded O-ring?			✓	
B. O-ring Damage/Defects?			✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/8/92

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Lyas.

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Break away torque 36
Running torque 12

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sll Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/8/92

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Lyons

Location: Nose Inlet-to-Throat (Joint #3)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/8/92

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Lyons

Location: Nose Inlet-to-Throat (Joint #3)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ________

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92
Assessment Engineer(s)/Inspector(s): Art Merritt		
Joint: Throat-to-Forward Exit Cone (Joint #4)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?		✓	
D. RTV in Contact With or Past the Primary O-ring?	✓		1
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	
H. Corrosion?	✓		2
I. Metal Damage?		✓	

Notes / Comments

Special Issue 3.2.3.2

1. RTV in contact with the primary O-ring for 75% of the full circumference. RTV did not flow by the O-ring at any point.

2. Typical light-medium corrosion intermittently full circumference between the primary and secondary seals. Heavy corrosion and pitting on the primary sealing surface of the throat housing at the following locations: 40°, 50-52°, 58-70°, 90-92°, 125-135°, 145-159°, 165-185°, 192-210°, 215-220°, 230-2525°, 285°, 340°. Photos were taken at two locations: 127986-1 and 127986-2. A preliminary PFAR was written on the heavy corrosion.

Special issue 3.2.3.2: The throat support housing seal zones were evaluated with the extended seal zone criteria. The previous observations take the seal zone into account.

Preliminary PFAR(s)? ✓ Yes ____ No   Preliminary PFAR Number(s): 45C-01

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): B-25A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt, Marvin Lyon

Joint: Throat-to-Forward Exit Cone (Joint #4)

Primary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Marriott

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	

Leak Check Port Observations:	Yes	No	Comment #
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	1

Notes / Comments

1. Leak Check through hole was not obstructed but did contain some grease.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merrit

Location: Throat-to-Forward Exit Cone (Joint #4)

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Break torque 39 in-lb
Running torque 9 in-lb

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merriet

Location: Throat-to-Forward Exit Cone (Joint #4)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-3
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merrott

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Soot To or Past O-rings?		✓	
B. Heat Affected Metal?		✓	
C. Foreign Material?	✓		1
D. RTV in Contact With or Past the Primary O-ring?		✓	
E. O-ring Damage (In Groove)?		✓	
F. Heat Affected or Eroded O-rings (In Groove)?		✓	
G. Excessive or No Grease?		✓	2
H. Corrosion?	✓		3
I. Metal Damage?		✓	

Notes / Comments

Special Issue 3.2.3.1

1. Typical water droplets were observed full circumference between the primary and secondary seals.
   Typical Nylok in slot between primary and secondary seals on the housing assembly.
2. A heavy coat of grease (not excessive) was observed between the primary and secondary seals.
3. Typical light corrosion between the primary and secondary seals on both facing surfaces circumference intermittently. Water spots from splashdown were observed on the primary sealing surface of the fixed housing.

Special issue 3.2.3.1: The spotfaces of the fixed housing appeared in good condition, the chamfers did not appear to have any deformations that could be detected visually. (The P/R were not logged separately but were inspected as a group.)

Preliminary PFAR(s)? ______ Yes __✓__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-5
Large Diameter (Joint) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merritt, Marlin Lyon

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

	Yes	No	Comment #
Primary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	
Secondary O-ring Observations:			
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Damage/Defects?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-1
Leak Check Plug/Sil and Port Condition (At Removal)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92
Assessment Engineer(s)/Inspector(s): Art Macintl		
Location: Aft End Ring-to-Fixed Housing (Joint #5)		

Leak Check Plug Observations:	Yes	No	Comment #
A. Sooted Metal Surfaces?		✓	
B. Soot To or Past O-ring?		✓	
C. Foreign Material?		✓	
D. O-ring Damage (In Groove)?		✓	
E. Heat Affected or Eroded O-ring (In Groove)?		✓	
F. Excessive or No Grease on O-ring?		✓	
G. Excessive Grease on Plug?		✓	
H. Corrosion?		✓	
I. Thread Damage (Visible at Removal)?		✓	
Leak Check Port Observations:			
J. Sooted Metal Surfaces?		✓	
K. Foreign Material?		✓	
L. Excessive Grease?		✓	
M. Corrosion?		✓	
N. Metal Damage?		✓	
O. Heat Affected Metal?		✓	
P. Obstructed Through Hole?		✓	

Notes / Comments

Break torque : 37 in-lbs
Running torque : 10 in-lbs

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

ification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-4
Leak Check Plug/Sil Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92
Assessment Engineer(s)/Inspector(s): Art Merrit		
Location: Aft End Ring-to-Fixed Housing (Joint #5)		

Leak Check Plug Observations:	Yes	No	Comment #
A. Foreign Material Between the O-ring and Plug?		✓	
B. Heat Affected Metal?		✓	
C. Seal Surface/Thread Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-6
Small Diameter (Leak Check Plug/SII) O-ring Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merriott

Location: Aft End Ring-to-Fixed Housing (Joint #5)

Secondary O-ring Observations:	Yes	No	Comment #
A. Heat Affected or Eroded O-ring?		✓	
B. O-ring Defects/Damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-8
Packing With Retainer Condition (Detailed)

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4/7/92

Assessment Engineer(s)/Inspector(s): Art Merrit

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Packing With Retainer Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Seal or Retainer?		✓	
B. Seal or Retainer Damage/Defects?	✓		1
C. Corrosion?	✓		2

Notes / Comments

Special Issue 3.2.3.1

1. 67/72 packing with retainers had seal or retainer damage due to assembly/disassembly
2. 72/72 packing with retainers had typical discoloration on the retainer

Special Issue 3.2.3.18
Note: Stat-O-seals were not individually bagged.
The spotfaces had no rounding that was observable. Damage to the retainers was typical and due to disassembly.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 30 JUN 1992
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: Forward Dome		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9

Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 30 JUN 1992
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: Forward		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes __X__ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes __X__ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 30 Sept 92
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: Forward Center		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9

Case Factory Joint Condition

~~or No.: 360T021 (STS-45)	Side: Right (B)	Date: 9-8-92

Assessment Engineer(s)/Inspector(s): G. Rich

Factory Joint: Aft Center

Case Factory Joint Observations:	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		✓	
B. Heavy Corrosion in Joint?		✓	
C. Heavy Corrosion in Leak Check Port?		✓	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 17 JUN 1992

Assessment Engineer(s)/Inspector(s): D Birch

Factory Joint: ET Attach/Stiffener

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		~~NONE~~ NEW	#1
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Special Issue 3.2.1.2: Assessment was performed per the PEEP. No anomalies were noted.

TANG OF ATTACH EXHIBITS EXCESSIVE PITTING BUT HAS BEEN PREVIOUSLY DOCUMENTED AND DISPOSITIONED ON D.R. RUN.

FRETTING NOTED AT 242° AFT OF STIFF. SEC. GROOVE WITH GOUGE EXTENDING FWD THRU LAND BETWEEN GROOVES WHICH [redacted] CREATED MODERATE RAISED METAL.

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 17 JUN 1992

Assessment Engineer(s)/Inspector(s): Darin Birch

Factory Joint: Stiffener/Stiffener

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) B-9
Case Factory Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 17 JUN 1992
Assessment Engineer(s)/Inspector(s): Darin Birch		
Factory Joint: Aft Dome		

Case Factory Joint Observations:

	Yes	No	Comment #
A. Heat Affected or Eroded Joint O-ring?		X	
B. Heavy Corrosion in Joint?		X	
C. Heavy Corrosion in Leak Check Port?		X	

Note: Heavy corrosion is defined as corrosion that causes pitting. It may be necessary to remove corrosion to determine if pitting has occurred; however, care should be taken not to damage the hardware. A cloth dampened with solvent or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ______ Yes __X__ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes __X__ No   Clarification Form Page No.(s): ______

TWR-60695

Appendix C
Nozzle PFORs

Final Postflight Hardware Evaluation Report
360T021 (RSRM-21, STS-45)

October 1992

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4764

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

NOZZLE REQUIRED EVALUATION FORMS LIST

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C-1	Nozzle Assembly Quick-look Condition	Left	N/A	C-1
C-2	Nozzle Joint Condition	Left	Joint #2	C-2
C-3	Nose Inlet-to-Flex Bearing-to-Cowl Joint Condition Drawing Worksheet	Left	Joint #2	C-3
C-2	Nozzle Joint Condition	Left	Joint #3	C-4
C-4	Nose Inlet-to-Throat Joint Condition Drawing Worksheet	Left	Joint #3	C-5
C-2	Nozzle Joint Condition	Left	Joint #4	C-6
C-5	Throat-to-Forward Exit Cone Joint Condition Drawing Worksheet	Left	Joint #4	C-7
C-2	Nozzle Joint Condition	Left	Joint #5	C-8
C-6	Aft End Ring-to-Fixed Housing Joint Condition Drawing Worksheet	Left	Joint #5	C-9
C-7	Cowl Insulation Segment Condition	Left	Cowl	C-10
C-8	Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition	Left	Flexible Bearing, Protector, & Boot	C-11
C-9	Flexible Bearing Protector Thickness Measurements	Left	Flexible Bearing Protector	C-12
C-10	Throat Diameter Measurements	Left	Throat	C-13

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C-11	Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition	Left	Outer Boot Ring & Flexible Boot	C-14
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Aft Exit Cone	C-15
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Forward Exit Cone	C-16
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Throat	C-17
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Forward Nose & Aft Inlet Rings	C-18
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Nose Cap	C-19
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Cowl	C-20
C-12	Nozzle Subassembly Phenolic Bondline Condition	Left	Fixed Housing	C-21
C-13	Cowl Ring Phenolic (SCP) Section Condition	Left	Cowl	C-22
C-14	Forward Exit Cone Phenolic (CCP) Section Condition	Left	Forward Exit Cone	C-23
C-15	Fixed Housing Phenolic (CCP) Section Condition	Left	Fixed Housing	C-24
C-16	Throat Inlet Assembly Phenolic (CCP) Section Condition	Left	Throat	C-25
C-17	Nose Cap Phenolic (CCP) Section Condition	Left	Nose Cap	C-26
C-18	Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition	Left	Forward Nose & Aft Inlet Rings	C-27

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

NOZZLE REQUIRED EVALUATION FORMS LIST (Cont.)

PFOR #	Title	Side	Joint, Part, or Location	Final Report Page Number
C-11	Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition	Right	Outer Boot Ring & Flexible Boot	C-41
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Aft Exit Cone	C-42
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Forward Exit Cone	C-43
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Throat	C-44
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Forward Nose & Aft Inlet Rings	C-45
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Nose Cap	C-46
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Cowl	C-47
C-12	Nozzle Subassembly Phenolic Bondline Condition	Right	Fixed Housing	C-48
C-13	Cowl Ring Phenolic (SCP) Section Condition	Right	Cowl	C-49
C-14	Forward Exit Cone Phenolic (CCP) Section Condition	Right	Forward Exit Cone	C-50
C-15	Fixed Housing Phenolic (CCP) Section Condition	Right	Fixed Housing	C-51
C-16	Throat Inlet Assembly Phenolic (CCP) Section Condition	Right	Throat	C-52
C-17	Nose Cap Phenolic (CCP) Section Condition	Right	Nose Cap	C-53
C-18	Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition	Right	Forward Nose & Aft Inlet Rings	C-54

(Note: Clarification PFORs will be inserted after the applicable required PFOR in the Final Report and will have the same page number as the required PFOR appended by a sequential alphabetic extension.)

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-1
Nozzle Assembly Quick-look Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-6-92
Assessment Engineer(s)/Inspector(s): L. E. WILKES		

Nozzle Assembly Quick-look Observations:

	Yes	No	Comment #
A. Metal Damage Due to Transportation or Handling?		✓	
B. Phenolic Damage Due to Transportation or Handling?		✓	
C. Foreign Material?		✓	

Notes / Comments

-liminary PFAR(s)? ______ Yes ___✓___ No Preliminary PFAR Number(s): ______

-larification Form(s)? ______ Yes ___✓___ No Clarification Form Page No.(s): ______

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): R. Quick		EW 4-8-92
Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Foreign Material?		✓	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		1
O. Excessive Grease in Threaded Bolt Holes?		✓	
P. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
Q. Bent or Broken Bolts?		✓	
R. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1 SEE PFOR FORM C-3 PAGE C-3.

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

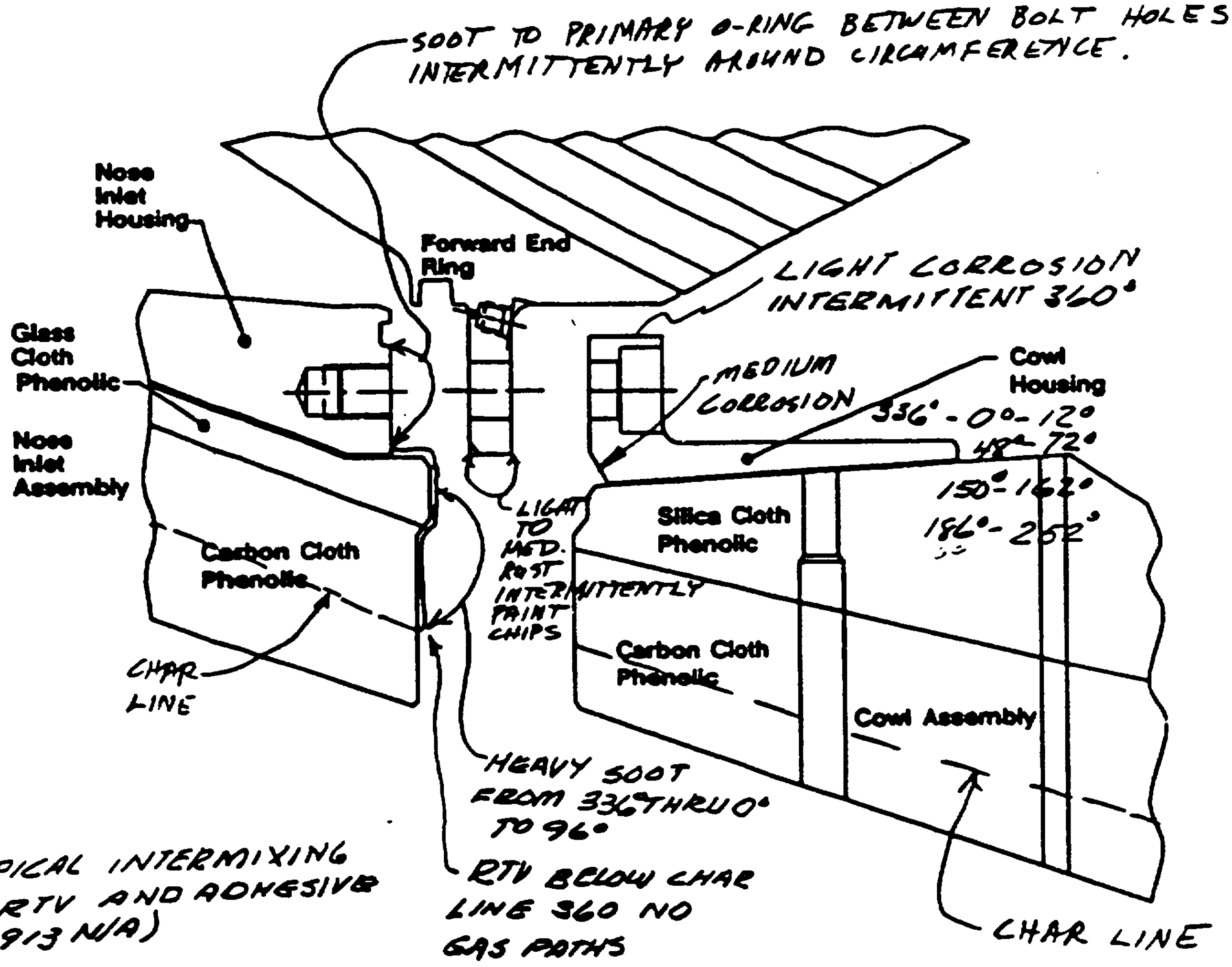
POSTFLIGHT OBSERVATION RECORD (PFOR) C-3

Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): R. QUICK / L.E. WILKES 4-8-92		

Sketch Observations Below (include locations and sizes of sketched features):

- TYPICAL JACK SCREW SCRATCH MARKS ON NOSE HOUSING FLANGE.
- LIGHT TO MEDIUM CORROSION ON BEARING FWD END RING FWD ID FLANGE INTERFACE AT 3 JACKSCREW HOLES



NO METAL DAMAGE

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ____________

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 4-8-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Joint: Nose Inlet-to-Throat (Joint #3)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	1
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		2
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		3
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments ① TYPICAL SALT WATER RESIDUE MIXED WITH GREASE.

Special Issue 3.2.3.2 — NO GAS PATHS WERE OBSERVED PAST EITHER O-RING.

② CHARRED CCP PLY DELAMINATIONS LOCATED INTERMITTENTLY AROUND CIRCUMFERENCE. VIRGIN CCP PLY DELAMINATIONS LOCATIONS AND SIZE ARE RECORDED ON PFOR FORM C-4 PAGE C-5 AND INTERFACE SEPARATION CLARIFICATION FORM PAGE C-4A.

③ SEE PFOR FORM C-4 PAGE C-5 FOR LOCATION & TYPE OF CORROSION FOUND IN JOINT 3

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-4A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-8-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Part:
- ☐ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☑ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:
- A. Metal-to-Adhesive
- B. Within Adhesive
- C. Adhesive-to-GCP
- D. Within GCP
- E. GCP-to-CCP
- F. Within CCP
- *G. Adhesive-to-SCP
- *H. Within SCP
- *I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
357°-0°-23°	F	.040 IN.
48°-68°	F	.050 IN.
132°-142°	F	.020 IN.
269°-275°	F	.030 IN.

Corresponding Comment Number(s): 2

REVISION ___

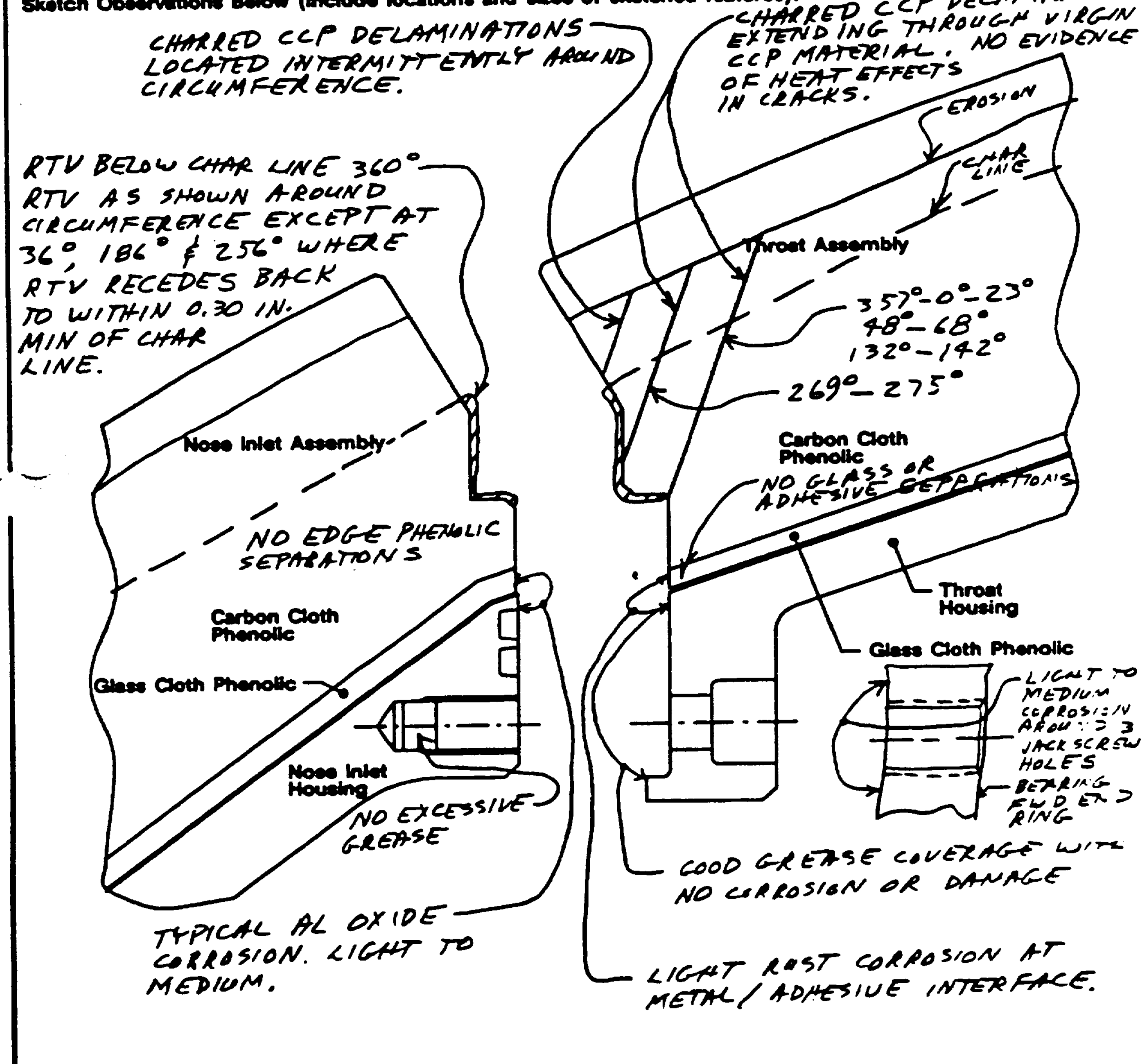
DOC NO. TWR-60695 | VOL
SEC | PAGE C-4A

POSTFLIGHT OBSERVATION RECORD (PFOR) C-4
Nose Inlet-to-Throat Joint (Joint #3) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-8-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Sketch Observations Below (include locations and sizes of sketched features):



...rification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		
Joint: Throat-to-Forward Exit Cone (Joint #4)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		2
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		3
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	4
S. Bent or Broken Bolts?	✓		5
T. Metal Damage (Joints or Housings)?	✓		5

Notes / Comments ① RTV TO HIGH PRESSURE SIDE OF PRIMARY O-RING FOR 90% OF CIRCUMFERENCE BUT DID NOT EXTEND PAST O-RING

Special Issue 3.2.3.2 — NO GAS PATHS WERE OBSERVED PAST EITHER O-RING.

② SEE NOZZLE INTERFACE SEPARATION CLARIFICATION FORM PAGE C-6A & C-6B

③ TYPICAL MEDIUM TO HEAVY CORROSION ON THROAT HOUSING/ADHESIVE INTERFACE ON HIGH PRESSURE SIDE OF PRIMARY O-RING LOCATED INTERMITTENTLY AROUND CIRCUMFERENCE. THE FWD. EXIT CONE ALSO SHOWED MEDIUM TO HEAVY CORROSION BETWEEN THE SECONDARY O-RING FOOTPRINT & ADHESIVE INTERFACE LOCATED INTERMITTENTLY AROUND CIRCUMFERENCE. PFAR'S WERE WRITTEN ON THESE CONDITIONS.

④ NO BOLT HOLE DAMAGE WAS OBSERVED, BUT DUE TO THE DAMAGED SNUBBER SHIM RETAINER SCREWS AND ONE SNUBBER SUPPORT RING SCREW, THERE MAY BE SOME DAMAGED HELICAL COIL THREADED HOLES.

⑤ SEE GENERAL HARDWARE CLARIFICATION FORM PAGE C-6C.

Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 45C-01 45C-02

Clarification Form(s)? ✓ Yes ___ No Clarification Form Page No.(s): C-6A, C-6B, C-6C

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Part:
- ☑ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:
- A. Metal-to-Adhesive
- B. Within Adhesive
- C. Adhesive-to-GCP
- D. Within GCP
- E. GCP-to-CCP
- F. Within CCP
- *G. Adhesive-to-SCP
- *H. Within SCP
- *I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
300° — 0° — 30°	A	0.04 IN.

Corresponding Comment Number(s): 2

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Part:
- ☐ Forward Exit Cone (Forward End)
- ☑ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:
- A. Metal-to-Adhesive
- B. Within Adhesive
- C. Adhesive-to-GCP
- D. Within GCP
- E. GCP-to-CCP
- F. Within CCP
- *G. Adhesive-to-SCP
- *H. Within SCP
- *I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
FULL CIRCUMFERENCE	A	0.022 IN.

Corresponding Comment Number(s): 2

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Description: SNUBBER ASSEMBLY DAMAGE

Sketch Observations Below (include locations and sizes of sketched features):

5 ELEVEN SNUBBER AXIAL SHIM RETAINERS AND SCREWS WERE DAMAGED FROM 187° TO 308°. FOUR RETAINER SCREWS WERE FRACTURED FLUSH WITH FWD EXIT CONE HOUSING FROM 229° TO 250° WITH THE TWO RETAINERS MISSING THERE. ALL OTHER RETAINER SCREWS IN THIS AREA SHOWED HEAD DAMAGE DUE TO CONTACT WITH BEARING AFT END RING AT SPLASHDOWN. SOME OF THE SCREW HEADS WERE DEPRESSED INTO THE RETAINERS, FLUSH WITH RETAINERS O.D. SURFACE.

ONE SNUBBER SUPPORT RING RETAINING SCREW WAS FRACTURED FLUSH WITH FWD EXIT CONE HOUSING. APPROXMATELY 10 OTHER SUPPORT RING SCREWS WERE BENT SLIGHTLY LOCATED FROM 187° TO 308°

Corresponding Comment Number(s): 5

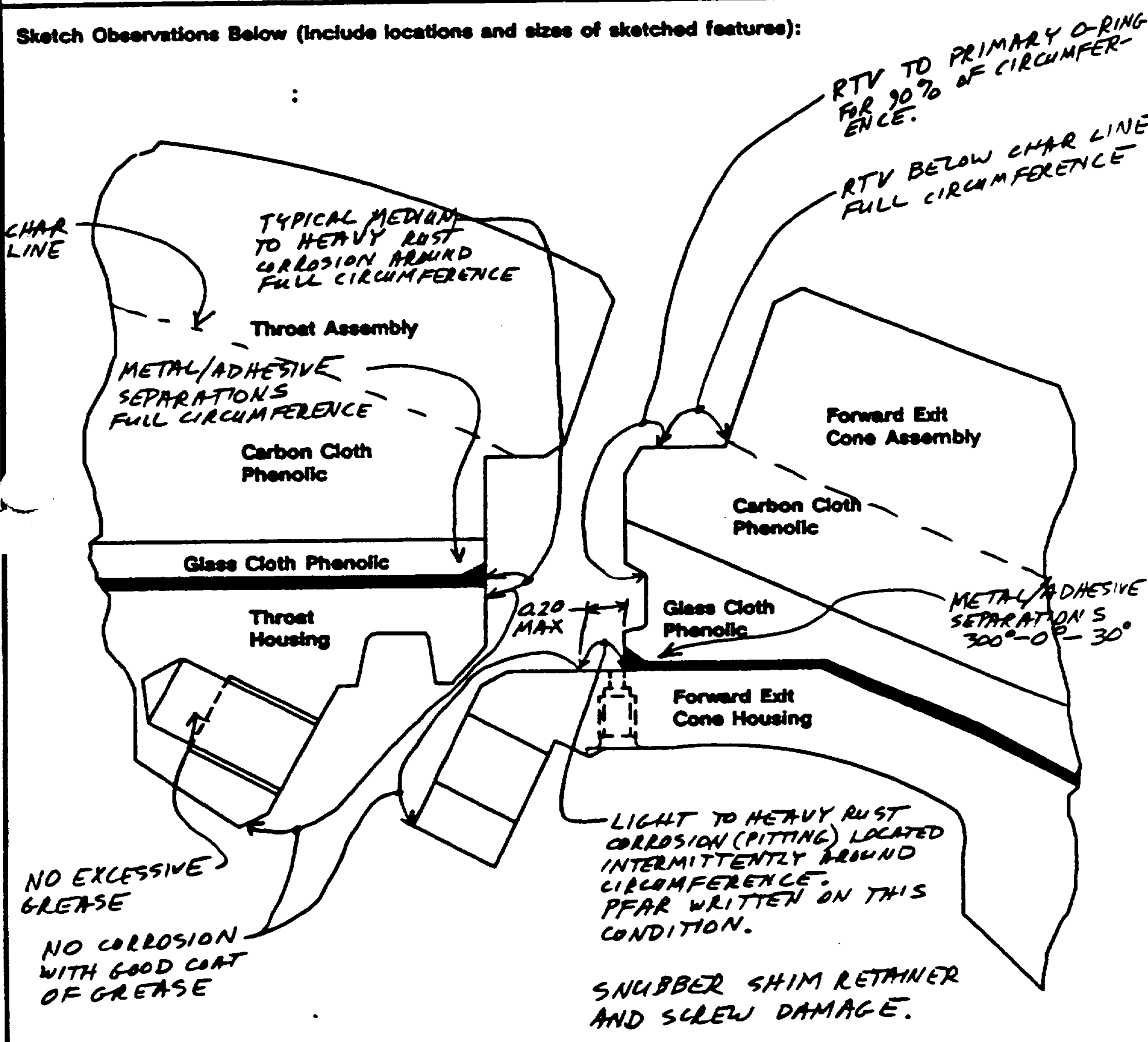
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-5

Throat-to-Forward Exit Cone Joint (Joint #4) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Sketch Observations Below (include locations and sizes of sketched features):



Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	2
E. Uncured RTV?		✓	
F. Voids Within RTV?	✓		3
G. Foreign Material?	✓		2
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		4
O. Alignment Pin Damage?		✓	
P. Excessive Grease in Threaded Bolt Holes?		✓	
Q. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
R. Bent or Broken Bolts?		✓	
S. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

(1) RTV REACHED PRIMARY O-RING AT 300° FOR 1.00 IN. CIRCUMFERENTIAL LENGTH BUT DID NOT EXTEND PAST O-RING.

(2) FOREIGN MATERIAL (APPEARS TO BE SMUDGE OF RTV) WAS OBSERVED BETWEEN THE TWO O-RINGS & BETWEEN TWO FLANGE BOLT HOLES AT 352°. IT MEASURED 0.50 IN. DIAMETER. PFAR WRITTEN.

REFERENCE PFOR PG B-30.

(3) TYPICAL INCAPSULATED RTV VOIDS WERE OBSERVED INTERMITTENTLY AROUND CIRCUMFERENCE BUT DID NOT EXTEND THRU THE JOINT. NO SOOT WAS FOUND IN VOIDS.

(4) MEDIUM TO HEAVY CORROSION LOC INTERMITTENTLY ON BEARING AFT END RING FLANGE CAVITY OD (ADJACENT TO SECONDARY O-RING) SURFACE.

...liminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 45C-04

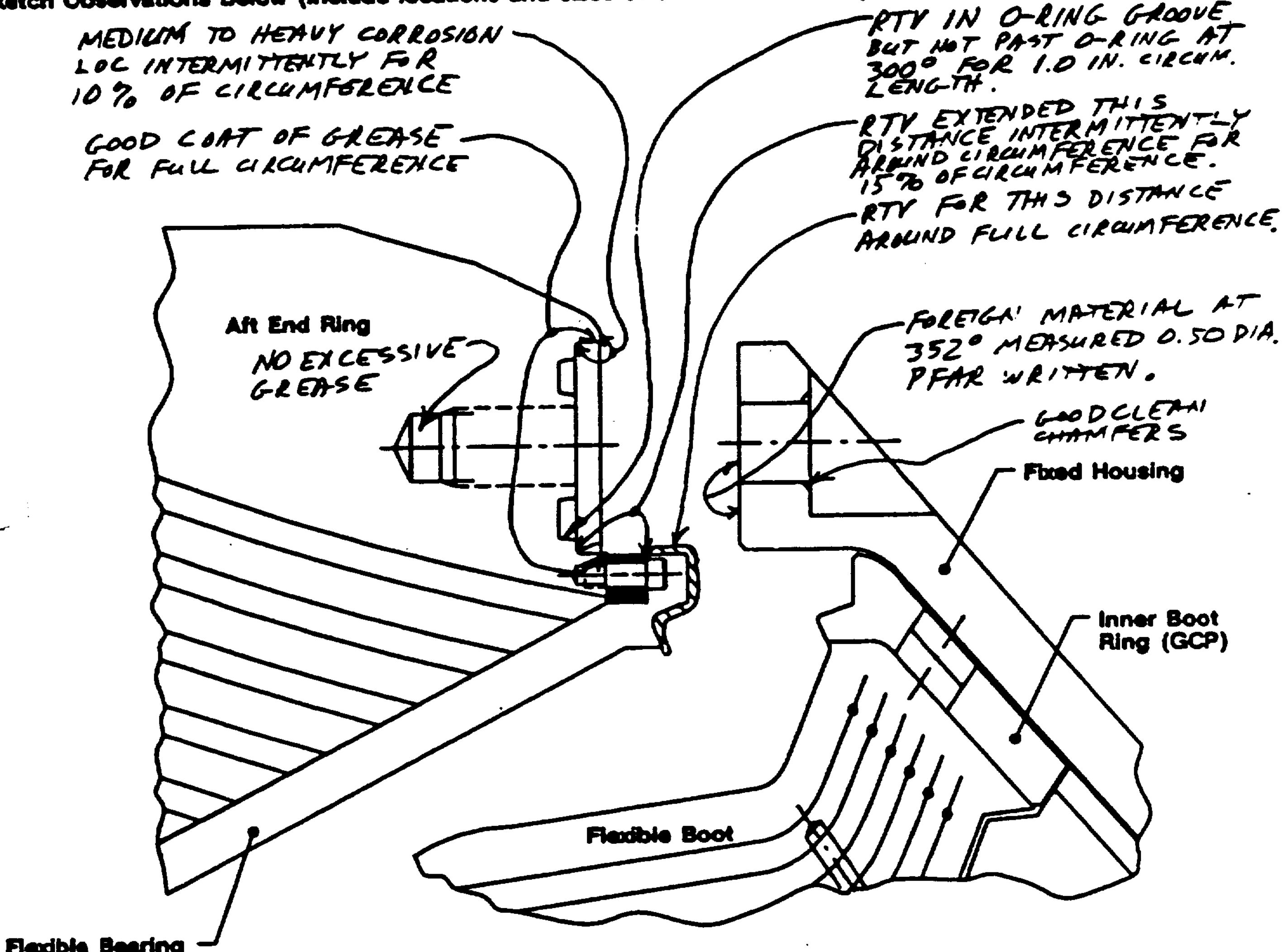
...ification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-6
Aft End Ring-to-Fixed Housing Joint (Joint #5) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Sketch Observations Below (include locations and sizes of sketched features):



NO METAL DAMAGE

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-7
Cowl Insulation Segment Condition

4-8-92 LEW

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Cowl Insulation Segment Observations:	Yes	No	Comment #
A. Spring Pin Holes Completely Through the Cowl Segment?		✓	
B. Abnormal Heat Effects or Erosion?		✓	1
C. Soot Between the Cowl Segment and Cowl Housing?		✓	
D. Bondline Failure Mode? Data Collection Only.	N/A	N/A	2

Notes / Comments

Special Issue 3.3.4 — SPRING PIN HOLE IN COWL HOUSING SEGMENT AT 300° DID NOT EXTEND THRU POSTFIRE SEGMENT THICKNESS.

1. SEE PFOR CLARIFICATION FORM PAGE C-10 A
2. BONDLINE FAILURE MODE WAS WITHIN THE INSULATION SEGMENTS OVER FULL LENGTH AND AROUND FULL CIRCUMFERENCE.

...liminary PFAR(s)? ____ Yes ____ No   Preliminary PFAR Number(s): ____

...larification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-10 A

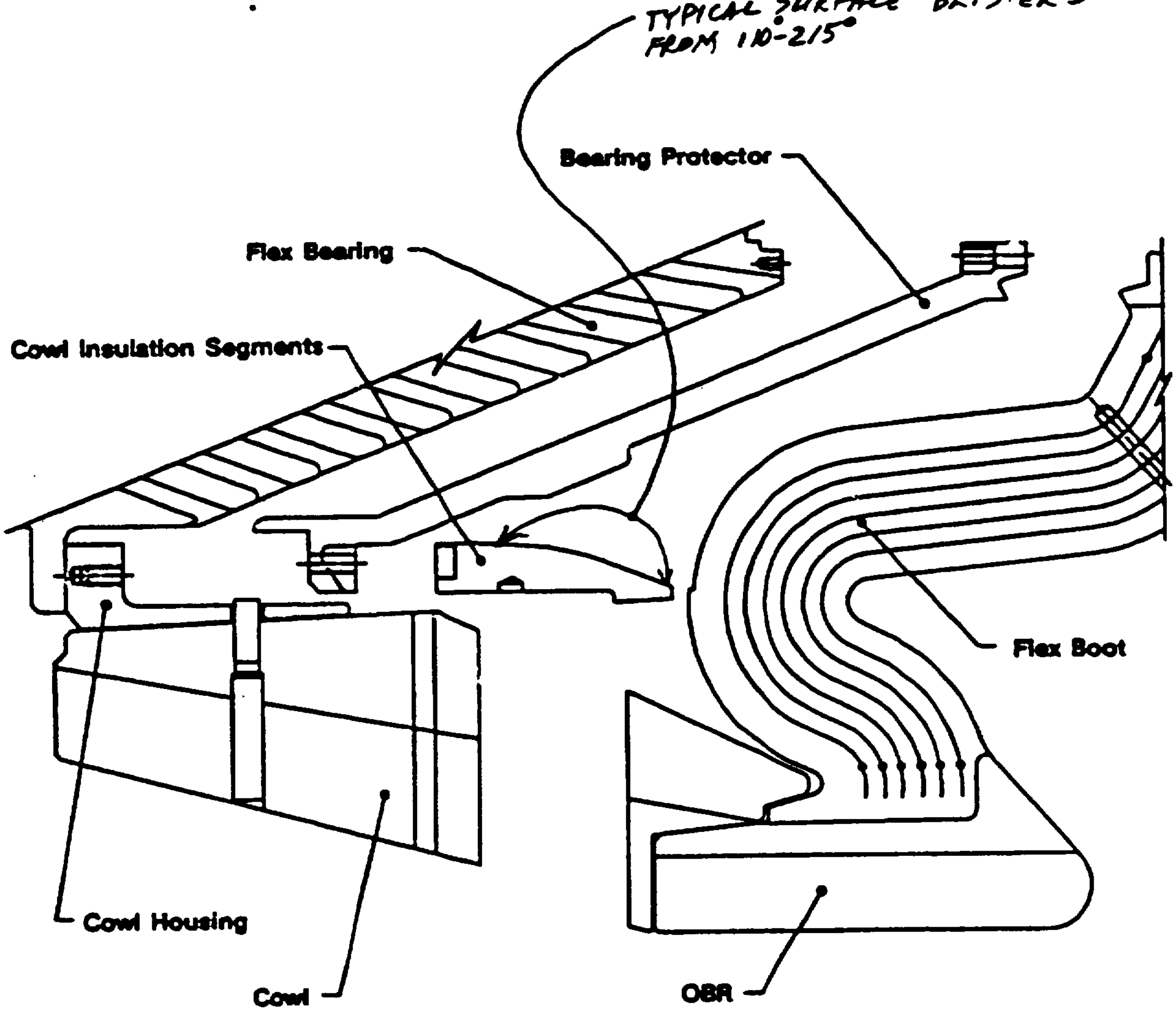
Flexible Boot Cavity Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☑ Left (A) ☐ Right (B) | Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Description: COWL HOUSING INSULATION SEGMENTS HEAT EFFECTS

Sketch Observations Below (include locations and sizes of sketched features):



Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-8
Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		LEW 4-8-92

Flexible Bearing, Bearing Protector, and Boot Observations:	Yes	No	Comment #
A. Bearing Protector Burn-Through?		✓	
B. Cracks Through the Bearing Protector?		✓	3
C. Bearing Protector Heat Effects or Erosion Other Than at Cowl Vent Hole Locations?		✓	
D. Soot Between the Bearing Protector and Flexible Bearing?		✓	
E. Heat Effects to the Flexible Bearing?		✓	
F. Bent or Broken Bearing Protector Bolts?	✓		2
G. Flexible Boot Burn-Through?		✓	
H. Abnormal Heat Effects or Erosion to Flexible Boot ID?		✓	
I. Foreign Material in Boot Cavity?		✓	1

Notes / Comments

① TYPICAL SLAG AND CHARRED BEARING PROTECTOR SURFACE & FLEX BOOT SURFACE MATERAL AND COWL DISASSEMBLY CUT SHAVINGS.

② FOUR OF THE 60 BEARING PROTECTOR FORWARD RING SCREWS WERE FRACTURED FLUSH WITH AFT FACE OF COWL HOUSING AT 234°, 237°, 243° & 249°. NO BENT BOLTS WERE OBSERVED. PFAR WRITTEN ON THIS CONDITION

③ THE BEARING PROTECTOR AFT GCP RING SHOWED 3 CRACKS AT SCREW HOLES.

...liminary PFAR(s)? ✓ Yes ____ No   Preliminary PFAR Number(s): 45C-05

...larification Form(s)? ____ Yes ✓ No   Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-9

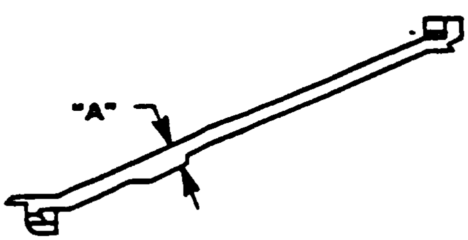
Flexible Bearing Protector Thickness Measurements

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 04-09-92

Assessment Engineer(s)/Inspector(s): [illegible]

Record the Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure) Below:

Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)
0	.699"	120	.702"	240	.715"
10	.701"	130	.708"	250	.713"
20	.704"	140	.702"	260	.705"
30	.707"	150	.709"	270	.710"
40	.703"	160	.704"	280	.704"
50	.705"	170	.700"	290	.710"
60	.704"	180	.703"	300	.711"
70	.700"	190	.701"	310	.712"
80	.697"	200	.707"	320	.710"
90	.696"	210	.709"	330	.706"
100	.705"	220	.706"	340	.707"
110	.705"	230	.712"	350	.704"



* "A" is the minimum thickness of the bearing protector in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-10
Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 04·08·92
Assessment Engineer(s)/Inspector(s): VAN BEUREKOM		

Record the Nozzle Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (inches)
0	55.935
45	55.926
90	55.920
135	55.936

Notes / Comments SC 45062

Clarification Form(s)? ______ Yes ___✓___ No   Clarification Form Page No.(s): N/A

REVISION ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-11

Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 4-14-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Flexible Boot/Outer Boot Ring Separation Observations:

	Yes	No	Comment #
A. Heat Effects in Boot/OBR Separation?		✓	

Record the Outer Boot Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
8.0	NA	1.00*	NA	.85	0.00	.85	NA	.95*
9.0	0.00	.83	.01	.82	0.00	.79	.01	.88
10.0	0.00	.86	.02	.84	0.00	.80	0.00	.87
11.3	0.00	.85	.02	.88	0.00	.90	0.00	.97
Add 6.8	NA	NA	NA	1.08*	NA	NA	NA	NA

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

ord the Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.4
90	3.1
180	3.1
270	3.1

Negative Margin of Safety? ____ Yes ✓ No Degree: ____

Notes / Comments * TOTAL AFFECTED DEPTH TO CHAR LINE.

Special Issue 3.3.2 Erosion and char are within the experience base. No unusual observations.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

ification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-20-92

Assessment Engineer(s)/Inspector(s): L. WILKES / T. FRESTON

Phenolic Subassembly: Aft Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive	5							
Within Adhesive	5							
Adhesive-to-GCP								
Within GCP	90							
GCP-to-CCP								
Within CCP								

ord Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

NA

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?	✓		1
B. Voids in Adhesive?		✓	
C. Corrosion?		✓	
D. Foreign Material?		✓	
E. Voids in Polysulfide (Aft Exit Cone Polysulfide Groove)?		✓	

Notes / Comments ① SEE CLARIFICATION FORM PAGE C-15A

eliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ✓ Yes ______ No   Clarification Form Page No.(s): C-15A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☑ Left (A) ☐ Right (B) | Date: 4-20-92

Assessment Engineer(s)/Inspector(s): L. WILKES / T. FRESTON

Nozzle Subassembly: AFT EXIT CONE ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
11	1.00	.60	34.00	✓	
24	1.10	.75	37.0	✓	
342	0.50	1.00	39.0	✓	
340	3.25	1.80	41.75	✓	

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-10-92

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Phenolic Subassembly: Forward Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	25	5	20	20				
Within Adhesive	20	20	30	30				
Adhesive-to-GCP	55	75	50	50				
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	N/A							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments

1) Voids documented on clarification forms C-16A & C-16B
2) Medium-to-heavy corrosion in areas of metal-to-adhesive separations

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-16A, C-16B

REVISION ____

C-3

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☑ Left (A) ☐ Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Nozzle Subassembly: Fwd Exit Cone

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
2	.90	.42	.85		✓
4	1.50	.65	23.28		✓
36	.50	.40	24.23		✓
66	.65	.37	3.55		✓
66	.85	.40	8.10		✓
71	1.40	.95	31.6		✓
137	.90	.55	9.2		✓
144	1.35	.50	6.8		✓
146	.90	.60	7.45		✓
146	.50	.35	11.9		✓
261	.55	.40	25.05		✓
274	.75	.48	30.40		✓
274	1.00	.40	31.8		✓

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☑ Left (A) ☐ Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Nozzle Subassembly: Fwd Exit Cone

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
274.5	.80	1.30	33.2		✓
285	1.65	.72	10.35		✓
342	2.35	1.25	6.6		✓
352	.70	.55	11.68		✓
358	3.90	.90	12.10		✓

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-15-92

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Phenolic Subassembly: Throat Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Throat Inlet — Degree Location — Throat Ring

	315-45	45-135	135-225	225-315	315-45	45-135	135-225	225-315
Metal-to-Adhesive	65	30		5	100	100	99	100
Within Adhesive								
Adhesive-to-GCP	5		20	15				
Within GCP		40					1	
GCP-to-CCP	30	30	80	80				
Within CCP								

ord Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Throat Inlet — Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	80	40	5	15				
Within Adhesive								
Adhesive-to-GCP	20	60	95	85				

Phenolic Removal Method: Wedge & Hand Peel

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments
1) Voids documented on clarification form C-17A
2) Medium-to-heavy corrosion in areas of metal-to-adhesive separation

minary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

larification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-17A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-15-92
Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston		
Nozzle Subassembly: Throat		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
95	7.20	2.15	0.090		✓
96	5.64	3.40	0.070		✓
110	4.18	2.0	0.23		✓
81	6.1	2.75	0.080		✓

Notes / Comments
1) All voids are "finger" voids due to air entering bondline during assembly.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-17-92

Assessment Engineer(s)/Inspector(s): J. Nelson, P. Miller

Phenolic Subassembly: Aft Inlet/Forward Nose Rings

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-90	90-180	180-270	270-360				
Metal-to-Adhesive	100	75	65	70				
Within Adhesive		10	10	10				
Adhesive-to-GCP		15	25	20				
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

Metal-to-Adhesive	N/A							
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments
1. Voids documented on clarification pg. C-19A
2. Medium to heavy corrosion in areas of metal to adhesive separations

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-19A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-17-92

Assessment Engineer(s)/Inspector(s): D. Nelson, P. Miller

Phenolic Subassembly: Nose Cap

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	10							
GCP-to-CCP	90							
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	0-90	90-180	180-360					
Metal-to-Adhesive	2	10	2					
Within Adhesive								
Adhesive-to-GCP	98	90	98					

Phenolic Removal Method: wedge, hand strip

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments

Special Issue 3.3.1 Prefire LOI at 242° correllates well with adhesive void at 244°. Other LOIs could not be found.

1. Voids documented on clarification pg. C-19A
2. Medium corrosion in metal-to-adhesive separation areas

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-19A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☑ Left (A) ☐ Right (B)	Date: 4-17-92

Assessment Engineer(s)/Inspector(s): O. Nelson, P. Miller

Nozzle Subassembly: As Noted

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
Nose Cap:					
151	.4	.25	12.6	✓	
212	.6	.4	2.3	✓	
244	1.2	.8	14.6	✓	
Forward Nose Ring:					
65	.8	.4	.7	✓	
241	.5	.3	2.8	✓	

Notes / Comments

Corresponding Comment Number(s): 1

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-10-92

Assessment Engineer(s)/Inspector(s): L. WILKES   R. TELLERS

Phenolic Subassembly: Cowl Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive	100%							
Within Adhesive								
Adhesive-to-SCP								
Within SCP								
SCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

N/A

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-SCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	1 & 3

Notes / Comments ① SEE PFOR CLARIFICATION FORM PAGE C-20A.

Special Issue 3.3.3 – BOND INTERFACE & FAILURE MODE WAS TYPICAL OF PAST HISTORY. NO EVIDENCE OF BOND CONTAMINATION OBSERVED.

Special Issue 3.3.5 – DR 407536 VOIDS OBSERVED AT 61°, 160°, 221° & 230° ARE SIMILAR TO LDI'S DESCRIBED IN SPECIAL ISSUES AT 65°, 155°, 216° & 238°.

② TYPICAL HEAVY CORROSION ON BOND INTERFACE & FWD OD CHAMFER FULL CIRCUMFERENCE.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-20A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☑ Left (A) ☐ Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): L. WILKES R. TELLERS

Nozzle Subassembly: COWL ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
61	2.30	0.40	0.00	✓	
160	2.40	1.80***	0.00	✓	
221**	1.60	0.40	0.00	✓	
230**	2.50	0.70***	0.00	✓	
240*	0.90	2.60***	0.00	✓	
250*	0.70	3.00***	0.00	✓	
260*	1.00	0.30	0.00	✓	
340	0.80	1.20***	0.00	✓	

Notes / Comments (3) RTV WAS OBSERVED MIXED WITH ADHESIVE AT 59°. THIS AREA MEASURED 1.20 IN. AXIAL MAX. AND 3.00 IN. CIRCUMFERENCE MAX. RTV MIXED WITH ADHESIVE WAS ALSO OBSERVED AT 135°. THIS AREA MEASURED 1.00 IN. AXIAL MAX. AND 0.40 IN. CIRCUMFERENCE MAX. NO OTHER FOREIGN MATERIAL WAS OBSERVED IN INTERFACE.

* RTV INTRUSION FILLED THIS VOID.

** RTV INTRUSION INTO FORWARD ONE THIRD OF THIS VOID ONLY.

*** THIS CIRCUMFERENTIAL WIDTH APPLIES AT FORWARD END ONLY. VOID TAPERS SMALLER TOWARD AFT END DISTANCE.

Corresponding Comment Number(s): 1 & 3

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 4-13-92

Assessment Engineer(s)/Inspector(s): L. WILKES / P. MILLER

Phenolic Subassembly: Fixed Housing Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
SEE NOTE 3 ← Metal-to-Adhesive	60	20		40				
Within Adhesive								
SEE NOTE 2 ← Adhesive-to-GCP	40	70	30	60				
Within GCP		10*	70*					
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

*

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	NA			NA				
Within Adhesive	↓			↓				
Adhesive-to-GCP		100	100					

Phenolic Removal Method: NYLON WEDGE & LARGE HAMMER

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?		✓	1
C. Corrosion?		✓	
D. Foreign Material?		✓	

Notes / Comments (1) TYPICAL INTERMITTENT SMALL VOIDS, LESS THAN 0.50 IN. DIAMETER AROUND FULL CIRCUMFERENCE.

(2) GCP BOND SURFACE NOT GRIT BLASTED: 315°-45° = 40%, 45°-135° = 20%, 135°-225° = 20%, 225°-315° = 40%. PFAR WRITTEN ON THIS CONDITION.

(3) FAILURE MODE FOR 4 SECTIONS IS 30% AVERAGE. PFAR WRITTEN ON THIS CONDITION.

Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 45C-09, 45C-10

Clarification Form(s)? ___ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-13
Cowl Ring Phenolic (SCP) Section Condition

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 4-27-92

Assessment Engineer(s)/Inspector(s): Larry Wilkes, Mark Clark

Cowl Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?	✓		1

Record the Cowl Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.3	.16	.77	.23	.67	.22	.66	.16	.71
1.0	.20	.79	.27	.65	.25	.71	.19	.69
2.0	.25	.80	.32	.68	.31	.69	.23	.62
3.0	.28	.88	.32	.69	.33	.67	.27	.68
4.0	N/A	N/A	.27	.72	.31	.67	.26	.73
5.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6.0 *	N/A	1.05	N/A	.98	N/A	.96	N/A	1.04
6.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments 1. Typical ply lifting observed.

Special Issue 3.3.2 → Total heat affected depth is within the experience base. No unusual observations.

Additional sections taken at 165° and 200°:

	165° Erosion	165° Char	200° Erosion	200° Char
0.3	.24	.69	.14	.70
1.0	.29	.62	.19	.70
2.0	.33	.64	.27	.75
3.0	.35	.64	.27	.75
4.0	.34	.64	N/A	N/A
5.0	N/A	N/A	N/A	N/A
6.0*	N/A	1.11	N/A	1.03

* All char measurements at Station 6.0 represent total heat affected depth.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-14
Forward Exit Cone Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 7-27-92
Assessment Engineer(s)/Inspector(s): M.E. Clark		

Forward Exit Cone Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Exit Cone Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	.34	.74	.32	.72	.34	.70	.37	.69
4.0	.36	.72	.31	.73	.34	.68	.38	.73
4.6	.35	.74	.30	.76	.36	.66	NA	NA
8.0	NA	NA	.32	.74	NA	NA		
12.0			NA	NA				
16.0								
20.0								
24.0								
28.0								
32.0								
32.9								
34.0								

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-15
Fixed Housing Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 7/27/92

Assessment Engineer(s)/Inspector(s): R. Quick

Fixed Housing Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Fixed Housing Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.0	.05	1.14	.03	1.32	0	1.04	0	1.23
1.0	0	1.07	0	1.08	0	.92	0	1.08
2.0	0	1.00	0	1.08	0	.88	0	1.06
3.0	0	.98	0	1.11	0	.86	0	1.02
4.0	0	.93	0	1.09	0	.88	0	1.00
5.0	0	.91	0	1.03	0	.86	0	1.02
6.0	0	.91	0	.99	0	.81	0	1.02
7.0	0	.89	0	.98	0	.81	0	1.02
8.0	0	.84	0	.88	0	.75	0	.89
9.0	0	.83	0	.86	0	.74	0	.83
10.75	NA	NA	NA	NA	.71	1.17	.48	1.28

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

Input

POSTFLIGHT OBSERVATION RECORD (PFOR) C-16
Throat Inlet Assembly Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45) | Side: Left (A) | Date: 7-14-92

Assessment Engineer(s)/Inspector(s): M. E. Clark, L. Wilkes

Throat Inlet Assembly Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Throat Inlet Ring and Throat Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	N/A	N/A	1.09	.59	1.03	.63	1.05	.69
2.0	1.10	.70	1.09	.60	1.04	.66	1.10	.68
4.0	1.16	.63	1.12	.66	1.10	.64	1.13	.68
6.0	1.19	.61	1.19	.62	1.18	.61	1.19	.66
8.0	1.20	.54	1.16	.63	1.20	.53	1.20	.60
10.0	1.11	.60	1.14	.55	1.18	.56	1.14	.66
12.0	1.12	.60	1.11	.60	1.13	.56	1.10	.68
14.0	1.11	.62	1.08	.60	1.11	.59	1.13	.61
16.0	1.06	.66	1.05	.61	1.07	.59	1.08	.67
18.0	.92	.74	.92	.65	.91	.71	.93	.73
20.0	.71	.75	.72	.67	.77	.72	.71	.78
22.0	.42	.82	.42	.78	.46	.89	.48	.82
23.0	.36	.81	.36	.83	.39	.85	.40	.86

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-17
Nose Cap Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 7-20-92
Assessment Engineer(s)/Inspector(s): L. Wilkes, M. Clark		

Nose Cap Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Nose Cap Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.5	NA	NA	NA	NA	NA	NA	NA	NA
4.0	.30	.74	.33	.65	.31	.69	.36	.64
6.0	.37	.64	.33	.62	.34	.65	.38	.69
8.0	.40	.61	.39	.56	.39	.59	.44	.65
10.0	.42	.61	.43	.54	.40	.55	.47	.59
12.0	.40	.63	.43	.59	.44	.55	.53	.64
14.0	.49	.62	.52	.54	.49	.57	.53	.62
16.0	.75	.49	.64	.49	.63	.43	.68	.60
18.0	.85	.50	.76	.59	.75	.49	.77	.56
20.0	.99	.56	.96	.57	.94	.54	.95	.72
22.0	1.58	.93	1.38	.75	1.40	.62	1.47	.79
24.0	1.82	.94	1.50	.74	1.57	.74	1.75	.86
26.0	1.34	.87	.99	.85	1.09	.78	1.27	.90

Negative Margin of Safety? ______ Yes ✓ No   Station: ______   Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-18
Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Left (A)	Date: 7-15-92

Assessment Engineer(s)/Inspector(s): R. Lange, M. Clark

Forward Nose and Aft Inlet Ring Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Nose Ring (-503) Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
28.0	1.14	.67	1.04	.68	1.00	.75	[illegible]	[illegible]
30.0	.92	.67	.90	.62	.85	.74	.74	[illegible]
32.0	.95	.60	.97	.53	.93	.63	1.00	[illegible]

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Record the Aft Inlet Ring Char (-504) and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
34.0	.89	.56	.85	.51	.85	.62	[illegible]	[illegible]
36.0	.89	.60	.86	.53	.85	.55	[illegible]	
38.0	.95	.62	.92	.54	.92	.57	[illegible]	[illegible]
39.0	.93	.62	.96	.57	.94	.57	[illegible]	[illegible]

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-1
Nozzle Assembly Quick-look Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-6-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Nozzle Assembly Quick-look Observations:	Yes	No	Comment #
A. Metal Damage Due to Transportation or Handling?		✓	
B. Phenolic Damage Due to Transportation or Handling?		✓	
C. Foreign Material?		✓	1

Notes / Comments

① SOME SAND CAME OUT OF CLEARFIELD HANDLING TOOL INTERNAL CAVITY ONTO FIXED HOUSING FLANGE DURING NOZZLE INVERSION OPERATIONS. SAND WAS CLEAN, PROBABLE FROM TOOL SAND BLAST CLEANING OPERATIONS.

NOTE: THE METAL STRAP INSTALLED AROUND THE OUTER BOOT RING AT KSC TO RETAIN OBR FRAGMENT REMAINED SECURELY IN PLACE. STRAP CUSHION PAD WILL BE REMOVED FROM FORWARD SIDE OF STRAP FOR DIS-ASSEMBLY COWL CUT.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): R. QUICK		
Joint: Nose Inlet-to-Flex Bearing-to-Cowl (Joint #2)		

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?	✓		1
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Foreign Material?	✓		2
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Separations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		1
O. Excessive Grease in Threaded Bolt Holes?		✓	
P. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
Q. Bent or Broken Bolts?		✓	
R. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1. SEE PFOR FORM C-3 PAGE C-30 AND PAGE C-29A.
2. SEE GENERAL CLARIFICATION FORM PAGE C-29A. PFAR WRITTEN ON FOREIGN MATERIAL IN JOINT PAST PRIMARY O-RING.

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 45C-26

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-29A

Thiokol CORPORATION
SPACE OPERATIONS

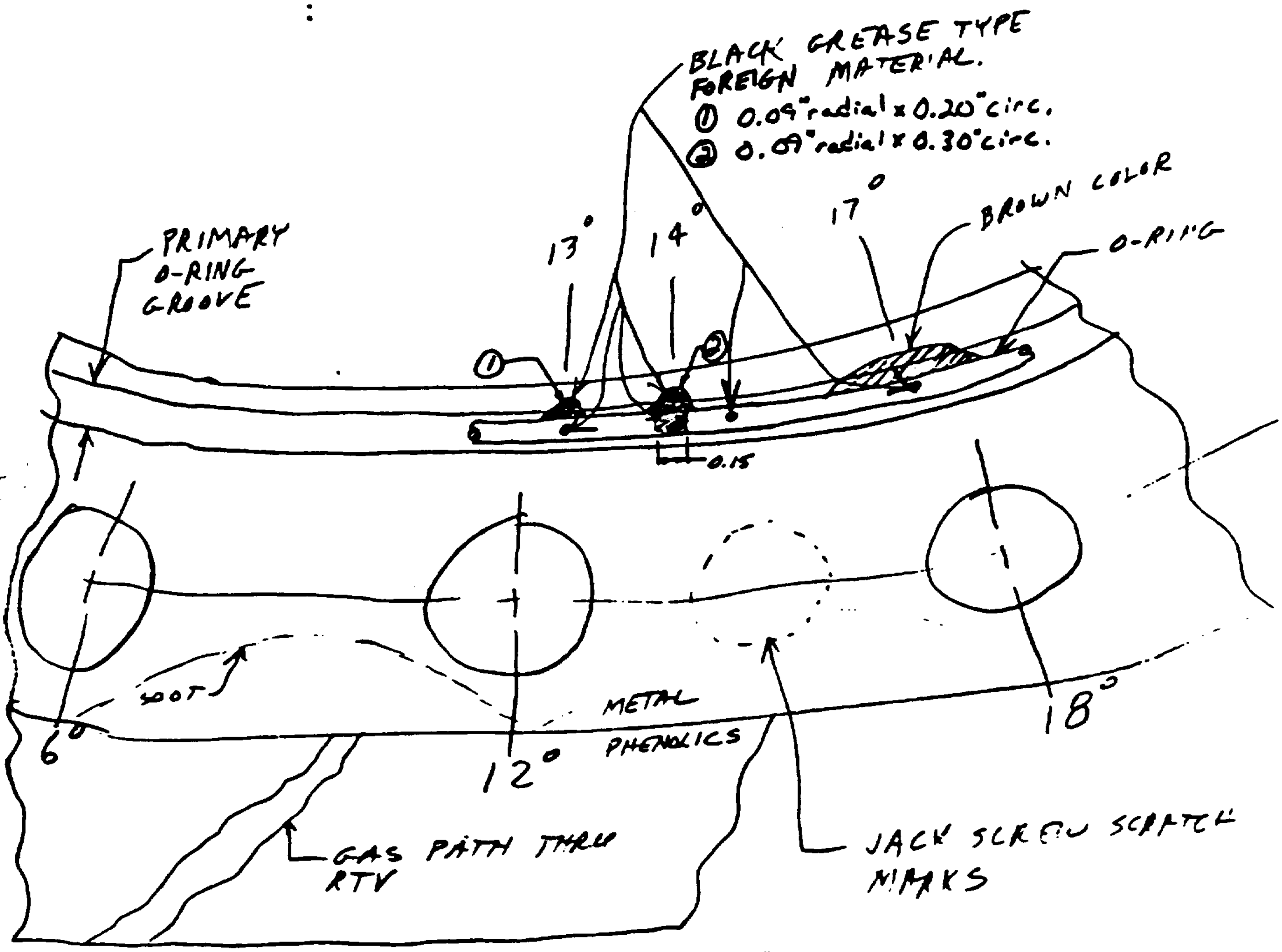
General Hardware Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☑ Right (B)	Date: 4-8-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Description: FOREIGN MATERIAL PAST PRIMARY O-RING IN JOINT 2

Sketch Observations Below (include locations and sizes of sketched features):



NOSE HOUSING JOINT 2

METHOL CHLOROFORM IN BOLT HOLES AT 6°, 12° & 18° TO DEPTH OF .50 IN MAXIMUM. MC IS USED TO CLEAN JACK SCREW HOLES BY DISASSEMBLY OPERATIONS

Corresponding Comment Number(s): 1, 2

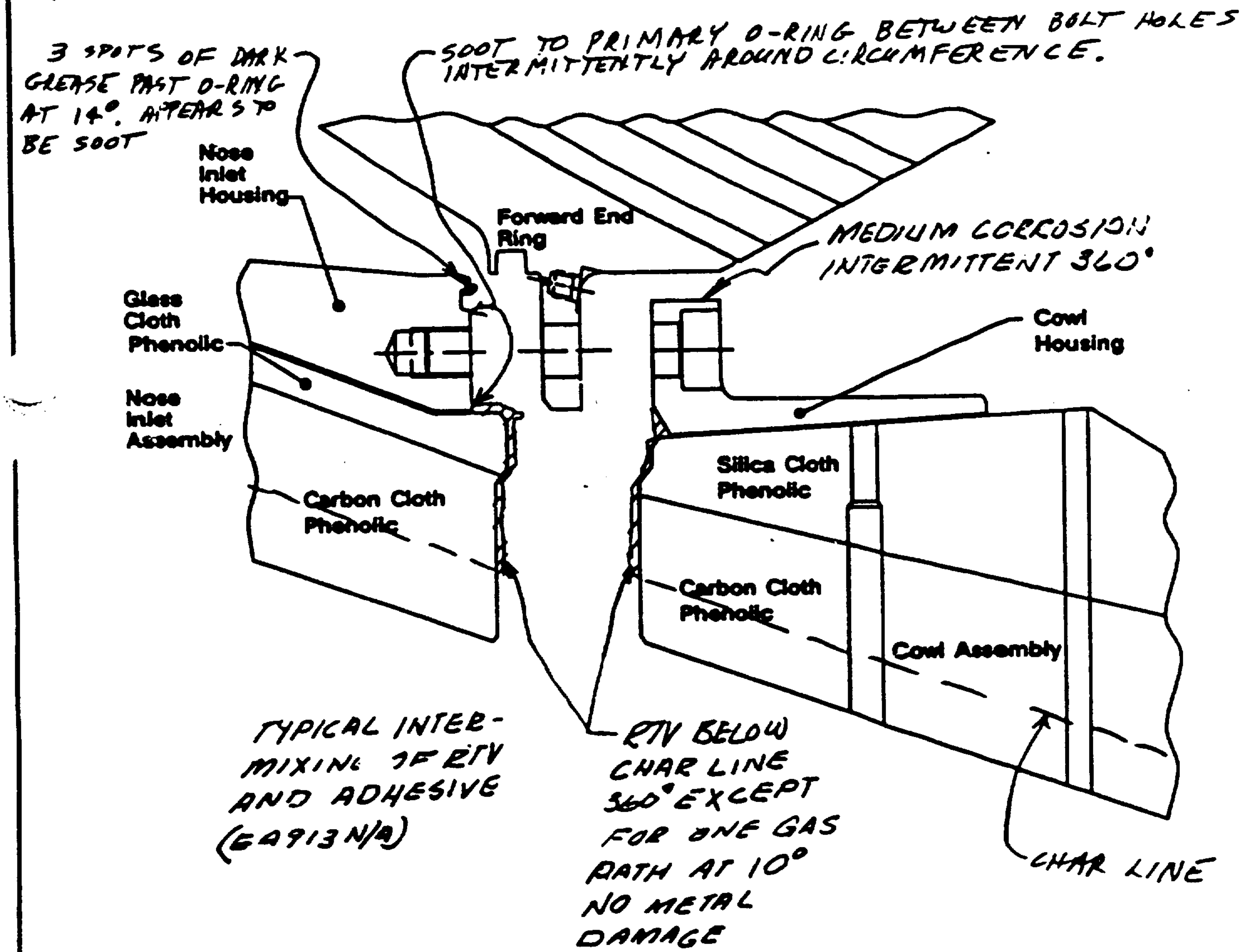
POSTFLIGHT OBSERVATION RECORD (PFOR) C-3

Nose Inlet-to-Flex Bearing-to-Cowl Joint (Joint #2) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92 LEW 4-8-92
Assessment Engineer(s)/Inspector(s): R. Quick / L.E. WILKES		

Sketch Observations Below (include locations and sizes of sketched features):

- TYPICAL JACK SCREW SCRATCH MARKS ON NOSE HOUSING
- LIGHT TO MEDIUM CORROSION ON BEARING FWD END RING FWD ID FLANGE INTERFACE AT THREE JACKSCREW HOLES.



Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2

Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-8-92

Assessment Engineer(s)/Inspector(s): R. Quick

Joint: Nose Inlet-to-Throat (Joint #3)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		#1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?	✓		#2
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		#3
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		SEE PG C-32
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

Special Issue 3.2.3.2 NO DAMAGE OR EXCESS CORROSION

#1 RTV REACHED PRIMARY O-RING 135°-143°

#2 UNCURED RTV FROM 120°-140° (SEE PG C-32)

#3 BOND LINE SEPARATIONS SEE C-31A

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ________

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-31A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☒ Right (B) | Date: 4-8-92

Assessment Engineer(s)/Inspector(s): R. Quick

Part:
- ☐ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☒ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:
- A. Metal-to-Adhesive
- B. Within Adhesive
- C. Adhesive-to-GCP
- D. Within GCP
- E. GCP-to-CCP
- F. Within CCP
- *G. Adhesive-to-SCP
- *H. Within SCP
- *I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
25-35	A	.005
40-42	A	.006
45-52	A	.005
60-70	A	.005
90-95	A	.005
100-110	A	.005
150-155	A	.005
164-198	A	.005
270-290	A	.005

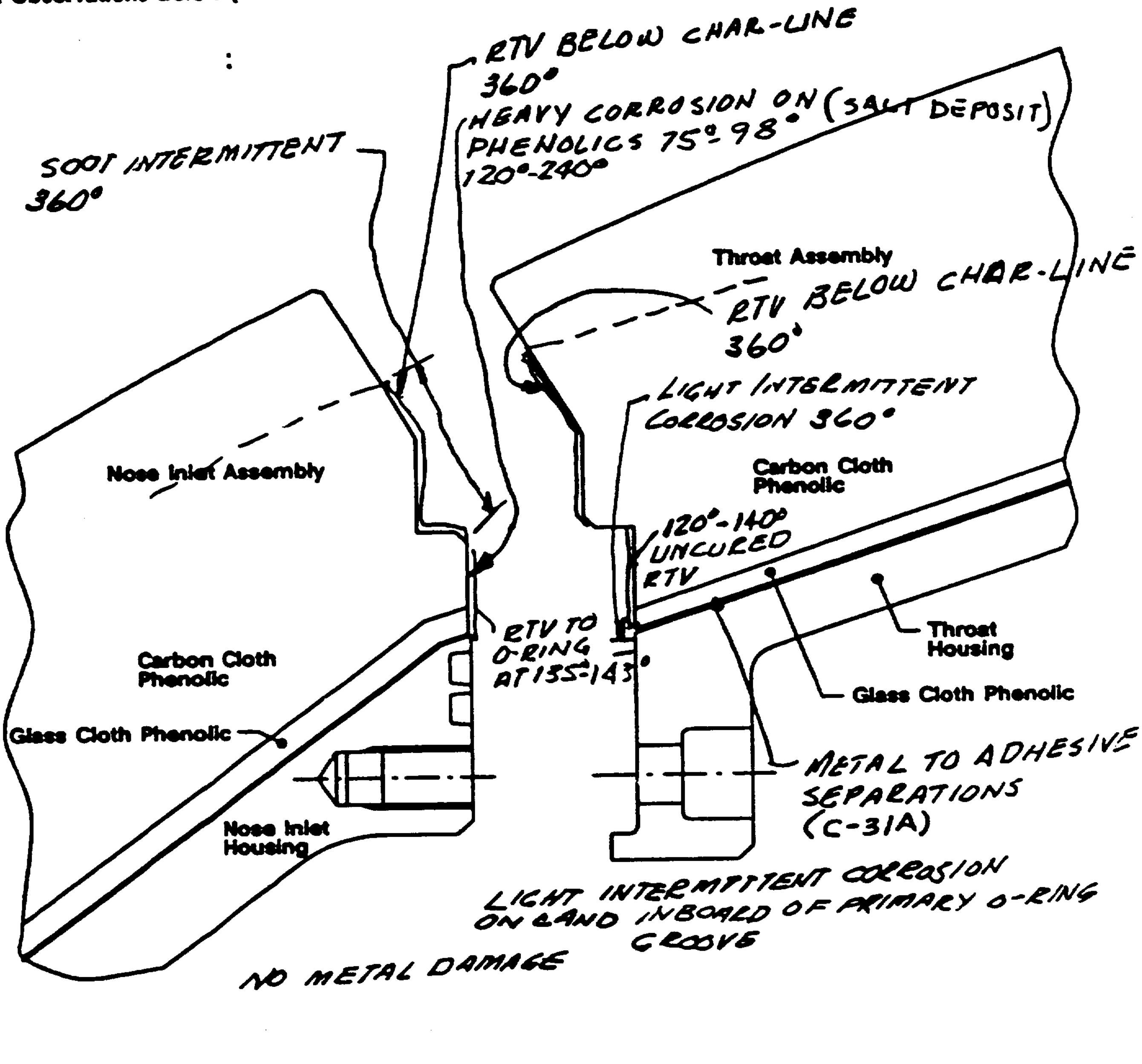
Corresponding Comment Number(s): 3

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-4
Nose Inlet-to-Throat Joint (Joint #3) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-8-92
Assessment Engineer(s)/Inspector(s): R. Quick		

Sketch Observations Below (include locations and sizes of sketched features):



Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2

Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Joint: Throat-to-Forward Exit Cone (Joint #4)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?	✓		1
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?		✓	
G. Grease Inhibiting RTV Backfill?		✓	
H. Foreign Material?		✓	
I. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
J. Damaged Phenolics?		✓	
K. Bondline Edge Separations? Use Clarification Form.	✓		2
L. Phenolics Axially Displaced From Housing?		✓	
M. Heat Affected Metal?		✓	
N. Unbonded or Blistered Paint?		✓	
O. Corrosion?	✓		3
P. Alignment Pin Damage?		✓	
Q. Excessive Grease in Threaded Bolt Holes?		✓	
R. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
S. Bent or Broken Bolts?		✓	
T. Metal Damage (Joints or Housings)?		✓	

Notes / Comments (1) RTV TO HIGH PRESSURE SIDE OF PRIMARY O-RING FOR 75% OF CIRCUMFERENCE, BUT DID NOT EXTEND PAST O-RING.

Special Issue 3.2.3.2 — NO GAS PATHS WERE OBSERVED PAST EITHER O-RING.

(2) SEE NOZZLE INTERFACE SEPARATION CLARIFICATION FORM PAGE C-33A & C-33B

(3) TYPICAL MEDIUM TO HEAVY CORROSION ON THROAT HOUSING/ADHESIVE INTERFACE ON HIGH PRESSURE SIDE OF PRIMARY O-RING LOCATED INTERMITTENTLY AROUND CIRCUMFERENCE. A PFAR WAS WRITTEN ON THIS CONDITION.

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 45C-01

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-33A, C-33B

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☑ Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Part:
- ☑ Forward Exit Cone (Forward End)
- ☐ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:

A. Metal-to-Adhesive
B. Within Adhesive
C. Adhesive-to-GCP
D. Within GCP
E. GCP-to-CCP
F. Within CCP
*G. Adhesive-to-SCP
*H. Within SCP
*I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
65° - 120°	E	0.060 IN.
140° - 215°	E	0.050 IN.

Corresponding Comment Number(s): 2

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Interface Separation Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Part:
- ☐ Forward Exit Cone (Forward End)
- ☑ Throat Ring (Aft End)
- ☐ Throat Inlet Ring (Forward End)
- ☐ Aft Inlet Ring (Aft End)
- ☐ Nose Cap (Aft End)
- ☐ Cowl (Forward End)*
- ☐ Inner Boot Ring (Forward End)

Interface Separation Types:
- A. Metal-to-Adhesive
- B. Within Adhesive
- C. Adhesive-to-GCP
- D. Within GCP
- E. GCP-to-CCP
- F. Within CCP
- *G. Adhesive-to-SCP
- *H. Within SCP
- *I. SCP-to-CCP

Circumferential Location	Separation Type	Maximum Radial Width
FULL CIRCUMFERENCE	A	0.040 IN.

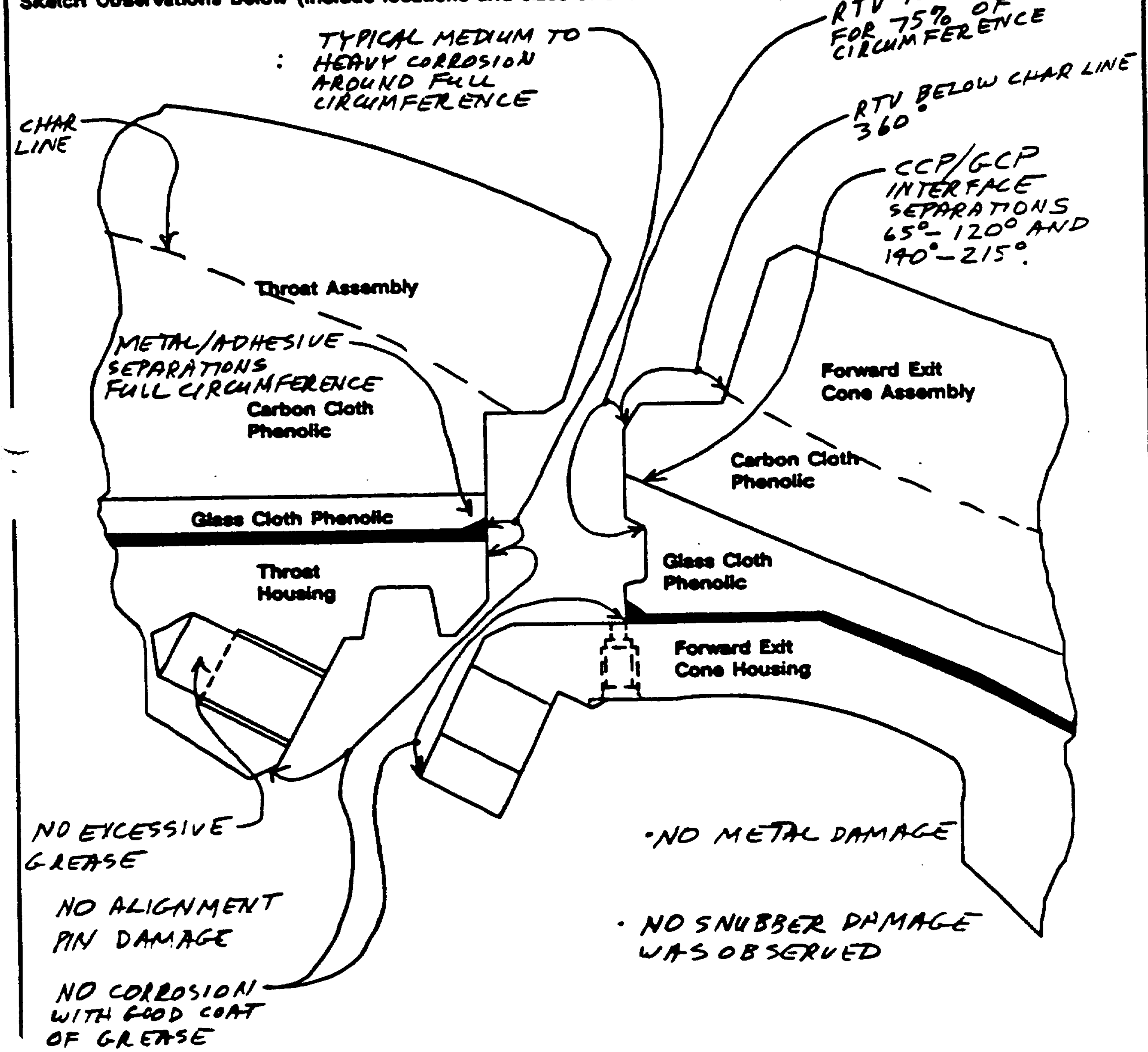
Corresponding Comment Number(s): 2

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-5
Throat-to-Forward Exit Cone Joint (Joint #4) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Sketch Observations Below (include locations and sizes of sketched features):



Clarification Form(s)? ______ Yes ___✓___ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-2
Internal Nozzle Joint Condition

Motor No.: 360T021 (STS-45) | **Side:** Right (B) | **Date:** 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Joint: Aft End Ring-to-Fixed Housing (Joint #5)

Internal Nozzle Joint Observations:	Yes	No	Comment #
A. Gas Penetration in the RTV (Terminated, Through)?		✓	
B. RTV Not Below Char Line?		✓	
C. RTV To the Primary O-ring?		✓	
D. RTV Past the Primary O-ring?		✓	
E. Uncured RTV?		✓	
F. Voids Within RTV?	✓		1
G. Foreign Material?		✓	
H. Heat Affected or Eroded Virgin CCP, GCP/SCP, or adhesive?		✓	
I. Damaged Phenolics?		✓	
J. Bondline Edge Seperations? Use Clarification Form.		✓	
K. Phenolics Axially Displaced From Housing?		✓	
L. Heat Affected Metal?		✓	
M. Unbonded or Blistered Paint?		✓	
N. Corrosion?	✓		2
O. Alignment Pin Damage?		✓	
P. Excessive Grease in Threaded Bolt Holes?		✓	
Q. Bolt Hole Damage (Through, Threaded/Helical Coil Insert)?		✓	
R. Bent or Broken Bolts?		✓	
S. Metal Damage (Joints or Housings)?		✓	

Notes / Comments

1. TYPICAL INCAPSULATED RTV VOIDS WERE OBSERVED INTERMITTENTLY AROUND CIRCUMFERENCE, BUT DID NOT EXTEND THRU THE JOINT. NO SOOT WAS OBSERVED IN VOIDS

2. MEDIUM TO HEAVY CORROSION LOCATED INTERMITTENTLY AROUND CIRCUMFERENCE ON BEARING AFT END RING FLANGE CAVITY OD (ADJACENT TO SECONDARY O-RING) SURFACE

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No   Clarification Form Page No.(s): ______

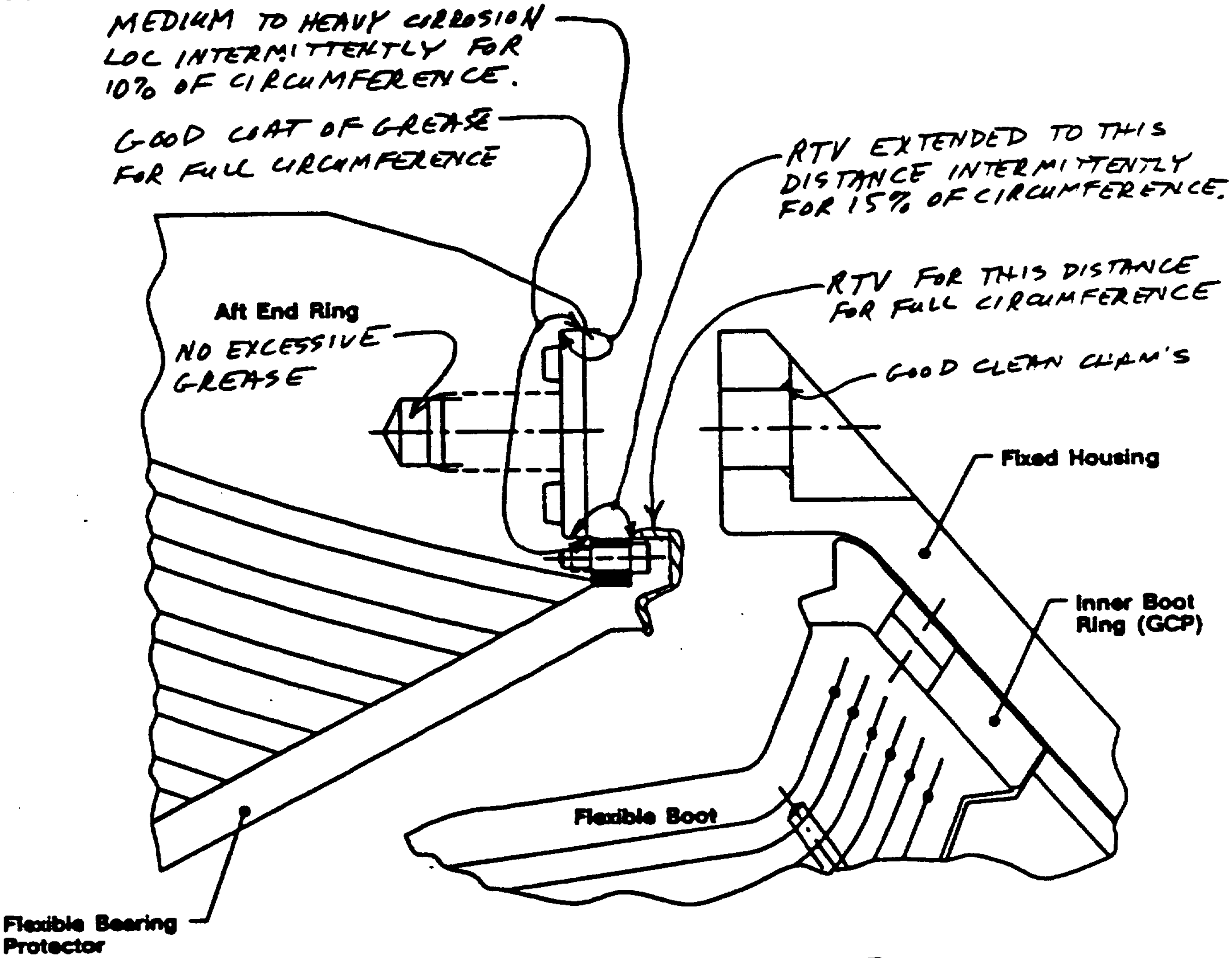
Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-6

Aft End Ring-to-Fixed Housing Joint (Joint #5) Condition Drawing Worksheet

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Sketch Observations Below (include locations and sizes of sketched features):



NO METAL DAMAGE

Clarification Form(s)? ______ Yes __✓__ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-7
Cowl Insulation Segment Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Cowl Insulation Segment Observations:	Yes	No	Comment #
A. Spring Pin Holes Completely Through the Cowl Segment?		✓	
B. Abnormal Heat Effects or Erosion?		✓	1
C. Soot Between the Cowl Segment and Cowl Housing?		✓	
D. Bondline Failure Mode? Data Collection Only.	N/A	N/A	2

Notes / Comments

1 SEE PFOR CLARIFICATION FORM C-37A

2 BONDLINE FAILURE MODE WAS WITHIN THE INSULATION SEGMENTS OVER FULL LENGTH AND CIRCUMFERENCE.

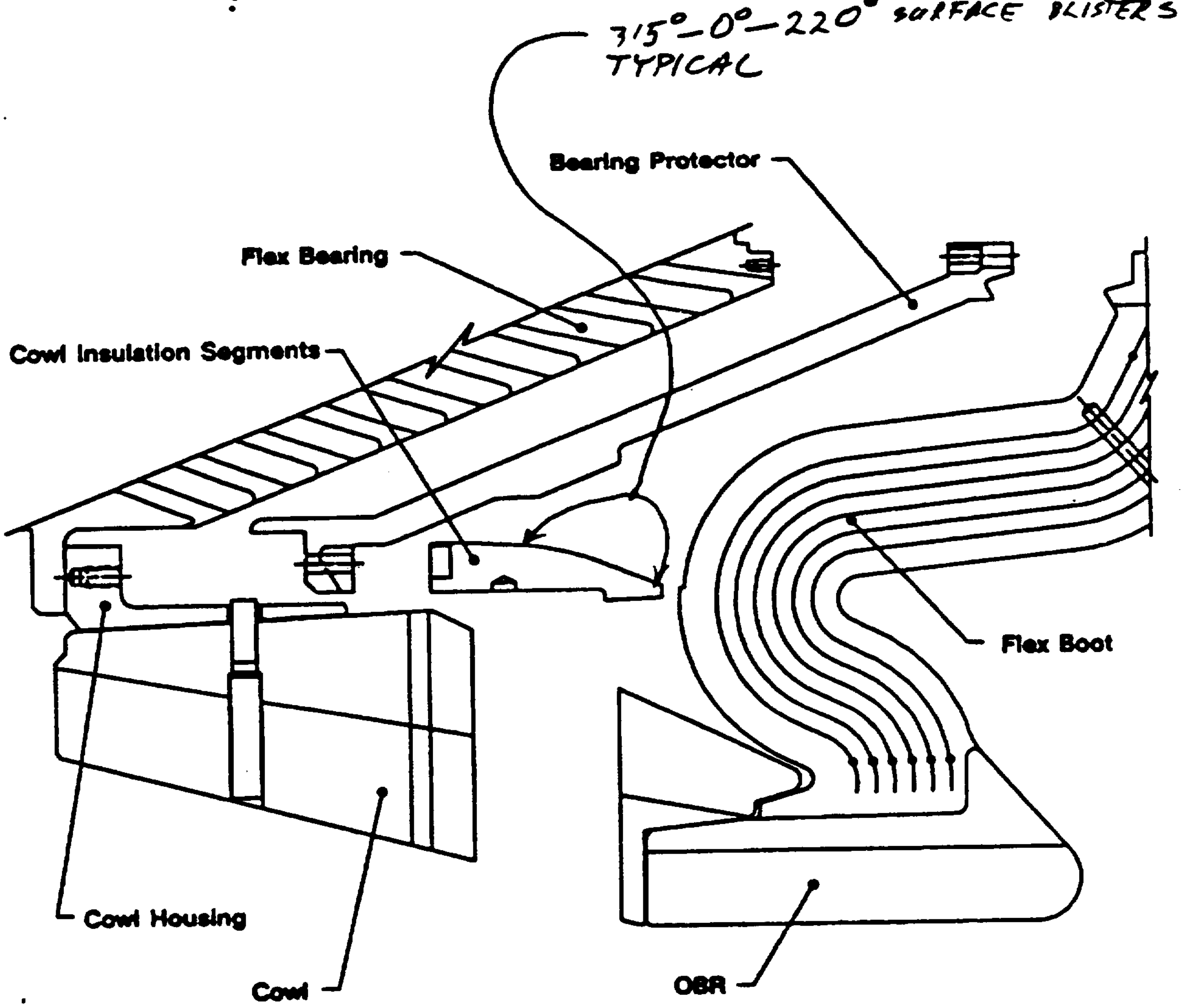
Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-37A

Flexible Boot Cavity Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☑ Right (B)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		
Description: COWL INSULATION SEGMENTS HEAT EFFECTS		

Sketch Observations Below (include locations and sizes of sketched features):



Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-8
Flexible Bearing, Flexible Bearing Protector, and Flexible Boot Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-7-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Flexible Bearing, Bearing Protector, and Boot Observations:	Yes	No	Comment #
A. Bearing Protector Burn-Through?		✓	
B. Cracks Through the Bearing Protector?		✓	2
C. Bearing Protector Heat Effects or Erosion Other Than at Cowl Vent Hole Locations?		✓	
D. Soot Between the Bearing Protector and Flexible Bearing?		✓	
E. Heat Effects to the Flexible Bearing?		✓	
F. Bent or Broken Bearing Protector Bolts?		✓	
G. Flexible Boot Burn-Through?		✓	
H. Abnormal Heat Effects or Erosion to Flexible Boot ID?		✓	
I. Foreign Material in Boot Cavity?		✓	1

Notes / Comments

1 TYPICAL SLAG AND BEARING PROTECTOR & FLEX BOOT CHARRED SURFACE MATERIAL AND COWL DISASSEMBLY CUT SHAVINGS.

2 THE BEARING PROTECTOR AFT GCP RING SHOWED 2 CRACKS AT SCREW HOLES.

...iminary PFAR(s)? ______ Yes ___✓___ No Preliminary PFAR Number(s): ______

...larification Form(s)? ______ Yes ___✓___ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

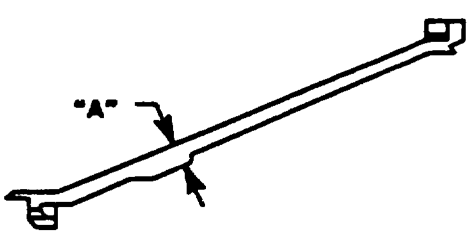
POSTFLIGHT OBSERVATION RECORD (PFOR) C-9
Flexible Bearing Protector Thickness Measurements

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 04-09-92

Assessment Engineer(s)/Inspector(s): Jed Berger

Record the Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure) Below:

Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)	Degree Location	Thickness Measurement "A"* (inches)
0	.710"	120	.719"	240	.713"
10	.719"	130	.721"	250	.711"
20	.714"	140	.720"	260	.701"
30	.718"	150	.714"	270	.705"
40	.713"	160	.713"	280	.711"
50	.714"	170	.718"	290	.705"
60	.705"	180	.708"	300	.716"
70	.708"	190	.703"	310	.721"
80	.720"	200	.718"	320	.710"
90	.712"	210	.714"	330	.717"
100	.718"	220	.719"	340	.705"
110	.715"	230	.716"	350	.716"



* "A" is the minimum thickness of the bearing protector in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

…minary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ______________

…larification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ______________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-10

Throat Diameter Measurements (Data Collection Only)

Motor No.: 360T021 (STS-45)	**Side:** Right (B)	**Date:** 04-09-92

Assessment Engineer(s)/Inspector(s): JBenton

Record the Nozzle Throat Diameter Measurements Below:

Degree Location	Diameter Measurement (Inches)
0	55.753"
45	55.754
90	55.801"
135	55.850"

Notes / Comments ~~SL46062~~ CJ 4-9-92
SL45062

...arification Form(s)? ______ Yes ___✓___ No   Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-11
Outer Boot Ring Char and Erosion Measurements and Flexible Boot Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-14-92

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Flexible Boot/Outer Boot Ring Separation Observations:

	Yes	No	Comment #
A. Heat Effects in Boot/OBR Separation?		✓	

Record the Outer Boot Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
8.0	NA	NA	.03	.90	.01	.87	.05	.84
9.0			.03	.80	0.00	.85	.05	.76
10.0			.01	.74	0.00	.82	.05	.68
11.3	NA	NA	0.00	.77	0.00	.79	.02	.91
cowl 6.8	NA	NA	NA	NA	NA	.97*	NA	.96*

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

…rd the Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.2
90	3.1
180	3.2
270	3.1

Negative Margin of Safety? ____ Yes ✓ No Degree: ____

Notes / Comments * TOTAL AFFECTED DEPTH TO CHAR LINE

…liminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

…arification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-20-92

Assessment Engineer(s)/Inspector(s): L. WILKES / R. SCHIFFMAN

Phenolic Subassembly: Aft Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive	5							
Within Adhesive								
Adhesive-to-GCP								
Within GCP	95							
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

N.A.

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?		✓	
D. Foreign Material?		✓	
E. Voids in Polysulfide (Aft Exit Cone Polysulfide Groove)?	✓		2

Notes / Comments (1) SEE CLARIFICATION FORM PAGE C-42A

Special Issue 3.3.8 (attach clarification form) SEE CLARIFICATION FORM PAGE C-42B

(2) SMALL INTERMITTENTLY VOIDS WITHIN POLYSULFIDE FOR FULL CIRCUMFERENCE; TYPICALLY WITH NO SOOT OR FOREIGN MATERIAL. (SMALL VOIDS ARE 0.30 INCH DIAMETER MAXIMUM.)

Preliminary PFAR(s)? ______ Yes ✓ No   Preliminary PFAR Number(s): ______

Clarification Form(s)? ✓ Yes ______ No   Clarification Form Page No.(s): C-42A, C42B

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☑ Right (B)	Date: 4-20-92

Assessment Engineer(s)/Inspector(s): L. WILKES / R. SCHIFFMAN

Nozzle Subassembly: AEC ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
2°	1.40	.55	5.5	✓	
22°	3.00	1.00	1.00	✓	
17°	1.00	.55	10.25	✓	
210	1.10	.50	13.25	✓	
218	1.00	.55	3.50	✓	
221	.75	.45	14.75	✓	

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

General Hardware Clarification Form

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-20-92
Assessment Engineer(s)/Inspector(s): L. WILKES / R. SCHIFFMAN		
Description: AEC ASSEMBLY		

Sketch Observations Below (include locations and sizes of sketched features):

Special Issue 3.3.8 LDI'S NOT VISIBLE WITHOUT CUTTING AXIALLY. THIS TASK WILL BE ACCOMPLISHED AT M-86 ON A LATER DATE.

REVISED, LARRY WILKES AND CHRIS PUTNAM 10-7-92.
PER TWR 60635 A SECTION APPROXMATELY 12 INCHES SQUARE WAS CUT FROM THE FORWARD END OF THE AEC PHENOLICS AT 261° AND 354°. EACH SECTION WAS CUT (AXIALLY) INTO 20 LONGITUDINAL SLICES. ALCOHOL WIPE INSPECTION WAS PERFORMED ON ALL SLICES AND NO WET-LINE INDICATIONS WERE FOUND. SOME SAMPLES WERE POLISHED AND EXAMINED UNDER A MICROSCOPE WITH NO INDICATIONS OF DELAMINATIONS, PORUS MATERIAL OR RESIN RICH AREAS BEING FOUND. REFERANCE MEMO L830-FY93-M051.

Corresponding Comment Number(s): N/A

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): M. Clark, P. Miller

Phenolic Subassembly: Forward Exit Cone Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	35	30	35	25				
Within Adhesive	20	15	20	20				
Adhesive-to-GCP	45	55	45	55				
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	NA							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments
1) Voids documented on clarification forms C-43A
2) Medium-to-heavy corrosion in areas of metal-to-adhesive separations.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-43H

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): M. Clark, P. Miller

Nozzle Subassembly: Fwd Exit Cone

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
189.4	.70	.40	15.8		✓
193	.90	.50	25.6		✓
193	1.70	.90	27.2		✓
202.5	.90	.70	24.1		✓
277.5	1.00	.50	7.1		✓
279.4	.80	.40	26.6		✓
140	.90	.50	1.3		✓
200	.70	.40	7.5		✓
271	1.50	.60	1.8		✓

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12

Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 4-15-92

Assessment Engineer(s)/Inspector(s): L. WILKES / T. FRESTON

Phenolic Subassembly: Throat Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive	100%							
Within Adhesive								
Adhesive-to-GCP								
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

N A.

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N.A.

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments ① TYPICAL SMALL VOIDS (0.50 IN. MAX. DIAMETER) LOCATED OVER FULL AXIAL LENGTH AND CIRCUMFERENCE. LARGER VOIDS ARE RECORDED ON CLARIFICATION FORM PAGE C-44A.
② TYPICAL HEAVY CORROSION OVER 95% OF BONDLINE INTERFACE SURFACES.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-44A

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-15-92

Assessment Engineer(s)/Inspector(s): L. WILKES / T. FRESTON

Nozzle Subassembly: Throat Assembly

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From	Fwd	Aft
280	4.2	1.2	3.32		✓
283	4.1	1.0	4.20		✓
285	2.5	0.47	6.60		✓

Notes / Comments

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-17-92

Assessment Engineer(s)/Inspector(s): L. WILKES / P. MILLER

Phenolic Subassembly: Aft Inlet/Forward Nose Rings

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-90	90-180	180-270	270-0				
Metal-to-Adhesive	95	100	100	90				
Within Adhesive	5							
Adhesive-to-GCP				10				
Within GCP								
GCP-to-CCP								
Within CCP								

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

N.A.

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments (1) SEE CLARIFICATION FORM PAGE C-45A FOR VOIDS
(2) INTERMITTENT LIGHT TO HEAVY CORROSION OVER FULL AXIAL LENGTH AND AROUND FULL CIRCUMFERENCE.

Preliminary PFAR(s)? ____ Yes ✓ No   Preliminary PFAR Number(s): ________

Clarification Form(s)? ✓ Yes ____ No   Clarification Form Page No.(s): C-45A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-17-92

Assessment Engineer(s)/Inspector(s): L. WILKES / P. MILLER

Nozzle Subassembly: NOSE INLET & AFT INLET RING.

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From	Fwd	Aft
* 24°	.40	.30	1.0	✓	
* 32°	.50	.30	1.10	✓	
* 21°	.30	.20	2.4	✓	
* 16°	.40	.20	1.0	✓	

Notes / Comments * VOIDS ON NOSE INLET RING FROM FWD END
SMALL (LESS THAN 0.30 IN DIAMETER) WERE OBSERVED OVER FULL AXIAL LENGTH AND FULL CIRCUMFERENCE INTERMITTENTLY.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-17-92
Assessment Engineer(s)/Inspector(s): L.E. WILKES / PETE MILLER		
Phenolic Subassembly: Nose Cap		

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	5	5	5	5				
GCP-to-CCP	95	95	95	95				
Within CCP								

ord Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	10	10	10	10				
Within Adhesive								
Adhesive-to-GCP	90	90	90	90				

Phenolic Removal Method: HAMMER, WEDGE & HAND PEEL

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?	✓		2
D. Foreign Material?		✓	

Notes / Comments ① SEE CLARIFICATION FORM PAGE C-46A FOR VOIDS AND SPECIAL ISSUES.

Special Issue 3.3.8 → SEE NOTE ③ ON CLARIFICATION FORM PAGE C-46A.

Special Issue 3.3.9 → SEE NOTE ③ ON CLARIFICATION FORM PAGE C-46A.

② INTERMITTENT LIGHT TO HEAVY CORROSION ON FORWARD 3.0 IN. AND ON AFT 3.0 IN AROUND FULL CIRCUMFERENCE.

iminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

larification Form(s)? ✓ Yes ______ No Clarification Form Page No.(s): C-46A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45)	Side: ☐ Left (A) ☑ Right (B)	Date: 4-17-92

Assessment Engineer(s)/Inspector(s): L. WILKES / P. MILLER

Nozzle Subassembly: NOSE CAP

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	* Void Size Axial	Circ.	Location on Bonding Surface Distance From	Fwd	Aft
31.5	.40	.30	6.2	✓	
89.5	.60	.50	14.1	✓	
178	.60	.40	9.5	✓	
247.5	.60	.40	9.7	✓	
350	.50	.30	1.7	✓	
355	.50	.40	15.4	✓	

Notes / Comments: (3) ADHESIVE VOIDS OBSERVED ON NOSE CAP INTERFACE AT LOCATIONS 89.5°, 178°, 247.5° AND 355° MATCH THE SIZE AND LOC OF LDI'S DESCRIBED ON DR-404282 AND DR-404295 AT LOCATIONS 90.7°, 177.7°, 247.5° AND 355.6° RESPECTIVELY. TWO VOIDS OBSERVED AT 31.5° AND 350° WERE NOT RECORDED ON DR'S BUT WERE ONLY 0.30 MAX WIDE, CIRCUMFERENTLY, WHICH IS THE LIMIT FOR EX-RAY INSPECTION. THE LDI RECORDED ON DR-404282 AT 45° IN THE GCP ALONG PLY ANGLE COULD NOT BE FOUND, DUE TO GCP BEING DISTROYED DURING REMOVAL.

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): L. WILKES R. TELLERS

Phenolic Subassembly: Cowl Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	0-360							
Metal-to-Adhesive	100 %							
Within Adhesive								
Adhesive-to-SCP								
Within SCP								
SCP-to-CCP								
Within CCP								

ecord Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

N/A

Degree Location

Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-SCP								

Phenolic Removal Method: N/A

Metal Housing Bondline Surface Observations:

	Yes	No	Comment #
A. Soot?	✓		1
B. Voids in Adhesive?	✓		2
C. Corrosion?	✓		3
D. Foreign Material?		✓	

Notes / Comments 1 SEE NOTE 1 ON PFOR CLARIFICATION FORM PAGE C-47A

Special Issue 3.3.7 — DR 407537. VOIDS OBSERVED AT 130° & 160° ARE SIMILAR TO LDI'S DESCRIBED IN SPECIAL ISSUES AT 126° & 164°.

2 SEE PFOR CLARIFICATION FORM PAGE C-47A

3 TYPICAL HEAVY CORROSION ON BOND INTERFACE & FORWARD OD CHAM FULL CIRCUMFERENCE.

liminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 45C-08

larification Form(s)? ✓ Yes ___ No Clarification Form Page No.(s): C-47A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-10-92

Assessment Engineer(s)/Inspector(s): L. WILKES R. TELLERS

Nozzle Subassembly: COWL ASSEMBLY

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From	Fwd	Aft
130	0.60	0.25	0.00	✓	
130	0.70	0.30	1.90	✓	
160	0.90	0.30	0.00	✓	
240	1.00	0.20	0.00	✓	

Notes / Comments (1) SOOT ON METAL (ALUMINUM) HOUSING/ADHESIVE INTERFACE SURFACE AT 10° BEGINNING AT FORWARD EDGE AND MEASURING 0.75 AXIAL AND 1.20 CIRCUMFERENCE MAX. A PFAR WAS WRITTEN ON THIS CONDITION (45C-18)

Corresponding Comment Number(s): 1, 2

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-12
Nozzle Subassembly Phenolic Bondline Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 4-13-92

Assessment Engineer(s)/Inspector(s): M. CLARK / R. TELLERS

Phenolic Subassembly: Fixed Housing Assembly

Record Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP			1					
Within GCP	70	60	60	80				
GCP-to-CCP	30	39	39	20				
Within CCP		1						

NOTE: SEE NOTE 3 FOR INNER BOOT RING-TO-FIXED HOUSING BONDLINE FAILURE MODE.

Record Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

Degree Location

	315-45	45-135	135-225	225-315				
Metal-to-Adhesive	1							
Within Adhesive								
SEE NOTE 2 ← Adhesive-to-GCP	99	100	100	100				

Phenolic Removal Method: WEDGE & HAND PEEL (SECONDARY)

Metal Housing Bondline Surface Observations:	Yes	No	Comment #
A. Soot?		✓	
B. Voids in Adhesive?	✓		1
C. Corrosion?		✓	
D. Foreign Material?		✓	

Notes / Comments ① VOIDS DOCUMENTED ON CLARIFICATION FORM C-48A
② INTERMITTENT RESIN RICH AREAS ON BOTH FORWARD AND AFT PORTION OF BONDLINE. VISIBLE AT GCP-TO-ADHESIVE INTERFACE. LARGEST AREAS LOCATED AT:
(A) 12°-40°, 2.5 IN. ON FORWARD END OF BONDLINE.
(B) 0°-30°, 1.9 IN. ON AFT END OF BONDLINE.
③ INNER BOOT RING INTERFACE SURFACE AREA SHOWED METAL-TO-ADHESIVE BONDLINE FAILURE MODE FROM 180° TO 225°.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Clarification Form Page No.(s): C-48A

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: 360T021 (STS-45) | Side: ☐ Left (A) ☑ Right (B) | Date: 4-13-92

Assessment Engineer(s)/Inspector(s): M. Clark, R. Tellers

Nozzle Subassembly: Fixed Housing

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface: Distance From	Fwd	Aft
28	1.00	0.40	4.00		✓
57	0.58	0.23	4.75	✓	
147	0.50	0.30	6.2	✓	
165	0.60	0.20	2.9		✓
188	0.60	0.30	3.0		✓
235	0.60	0.20	2.4		✓
305	0.80	0.35	0.10		✓
317	0.60	0.20	2.2	✓	

Notes / Comments

1) Intermittent small voids with a diameter of 0.20" or smaller

Corresponding Comment Number(s): 1

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-13
Cowl Ring Phenolic (SCP) Section Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 4-27-92

Assessment Engineer(s)/Inspector(s): Mark Clark, Larry Wilkes

Cowl Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Cowl Char and Erosion Measurements Below:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
0.3	.26	.62	.30	.63	.29	.68	.29	.66
1.0	.30	.65	.36	.65	.32	.69	.34	.67
2.0	.29	.71	.38	.66	.34	.71	.37	.71
3.0	.33	.68	.38	.61	.37	.76	.37	.72
4.0	N/A	N/A	N/A	N/A	.37	.72	.37	.67
5.0	N/A	N/A	N/A	N/A	.36	.70	.33	.65
6.0 *	N/A	1.01	N/A	1.00	N/A	1.09	N/A	.98
6.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

* All char measurements at station 6.0 represent total heat affected depth.

reliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

larification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-14
Forward Exit Cone Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 7-28-92
Assessment Engineer(s)/Inspector(s): M.E. Clark		

Forward Exit Cone Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Exit Cone Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	.35	.72	.37	.73	.36	.70	.37	.72
4.0	.36	.71	.36	.76	.35	.71	.35	.70
4.6	.35	.74	.35	.75	.35	.72	.37	.67
8.0	NA	NA	NA	NA	NA	NA	NA	NA
12.0								
16.0								
20.0								
24.0								
28.0	.27	.65						
32.0	.27	.61	.25	.77			.23	.69
32.9	.22	.63	.21	.78			.22	.70
34.0	.19	.65	NA	NA			NA	NA

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

REVISION ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-15
Fixed Housing Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 7/28/92
Assessment Engineer(s)/Inspector(s): R.Quick		

Fixed Housing Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Fixed Housing Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.0	0	1.15	0	1.12	.07	1.14	0	1.26
1.0	0	1.05	0	1.05	.02	1.07	0	1.19
2.0	0	.95	0	1.04	0	.98	0	1.06
3.0	0	.97	0	1.03	0	.91	0	1.09
4.0	0	.99	0	.99	0	.93	0	1.07
5.0	0	.98	0	.97	0	.96	0	1.08
6.0	0	.98	0	.99	0	.97	0	1.07
7.0	0	1.00	0	.97	0	.95	0	1.02
8.0	0	.90	0	.89	0	.74	0	.95
9.0	0	.95	0	.80	0	.76	0	.75
10.75	.15	.93	.39	1.58	NA	NA	.56	1.36

Negative Margin of Safety? ______ Yes ✓ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

Clarification Form(s)? ______ Yes ✓ No Clarification Form Page No.(s): ______

Thiokol CORPORATION
SPACE OPERATIONS

Input

POSTFLIGHT OBSERVATION RECORD (PFOR) C-16
Throat Inlet Assembly Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45) | Side: Right (B) | Date: 7-15-92

Assessment Engineer(s)/Inspector(s): R. Lange, M. Clark

Throat Inlet Assembly Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Throat Inlet Ring and Throat Ring Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0	1.03	.64	1.03	.59	1.09	.61	1.04	.53
2.0	1.06	.67	1.05	.57	1.12	.63	1.03	.56
4.0	1.13	.59	1.11	.61	1.17	.67	1.09	.57
6.0	1.18	.61	1.15	.63	1.19	.66	1.15	.60
8.0	1.20	.59	1.19	.60	1.23	.57	1.18	.56
10.0	1.12	.58	1.19	.51	1.16	.51	1.13	.54
12.0	[illegible]	.59	1.15	.58	1.18	.52	1.13	.59
14.0	1.09	.60	1.12	.56	1.19	.59	1.09	.59
16.0	1.10	.57	1.06	.63	1.11	.65	1.05	.58
18.0	.95	.66	.94	.68	.97	.67	.94	.61
20.0	.71	.77	.73	.77	.74	.74	.71	.68
22.0	.45	.80	.44	.89	.42	.79	.45	.71
23.0	.39	.84	.38	.83	.34	.89	.36	.82

Negative Margin of Safety? ______ Yes __✓__ No Station: ______ Degree: ______

Notes / Comments

Preliminary PFAR(s)? ______ Yes __✓__ No Preliminary PFAR Number(s): ____________

Clarification Form(s)? ______ Yes __✓__ No Clarification Form Page No.(s): ____________

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR) C-17
Nose Cap Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 7-27-92

Assessment Engineer(s)/Inspector(s): M.E. Clark

Nose Cap Phenolic Section Observations:

	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Nose Cap Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.5	.27	.74	NA	NA	NA	NA	NA	NA
4.0	.31	.61	.39	.58	.39	.58	.34	.61
6.0	.34	.69	.39	.66	.42	.60	.40	.61
8.0	.39	.67	.46	.64	.50	.54	.45	.65
10.0	.45	.58	.50	.59	.52	.55	.50	.59
12.0	.50	.61	.54	.61	.61	.58	.57	.57
14.0	.58	.46	.64	.52	.69	.55	.66	.47
16.0	.63	.52	.70	.53	.78	.55	.71	.50
18.0	.73	.54	.85	.56	.85	.60	.82	.52
20.0	.92	.58	1.05	.65	1.11	.61	1.05	.63
22.0	1.50	.69	1.61	.74	1.67	.79	1.56	.78
24.0	1.77	.81	1.75	.76	1.78	.79	1.75	.87
26.0	1.35	.80	1.21	.84	1.22	.87	1.27	.89

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

Thiokol CORPORATION
SPACE OPERATIONS

Insp. 7-22

POSTFLIGHT OBSERVATION RECORD (PFOR) C-18
Forward Nose Ring and Aft Inlet Ring Phenolic (CCP) Section Condition

Motor No.: 360T021 (STS-45)	Side: Right (B)	Date: 7-15-92

Assessment Engineer(s)/Inspector(s): R. Lange, M. Clark

Forward Nose and Aft Inlet Ring Phenolic Section Observations:	Yes	No	Comment #
A. Cross-ply cracking in virgin material?		✓	
B. Ply lifting?		✓	

Record the Forward Nose Ring (-503) Char and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
28.0	1.10	.63	1.11	.67	1.15	.60	NA	NA
30.0	.84	.62	.84	.60	.88	.56	.87	.64
32.0	.91	.54	.92	.60	.90	.62	.92	.59

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

ord the Aft Inlet Ring Char (-504) and Erosion Measurements Below:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
34.0	.88	.50	.87	.59	.88	.52	.90	.59
36.0	.86	.49	.90	.55	.87	.59	.92	.53
38.0	.91	.53	.96	.62	.94	.59	.98	.50
39.0	.94	.57	1.00	.63	.98	.64	1.02	.57

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

liminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

arification Form(s)? ____ Yes ✓ No Clarification Form Page No.(s): ____

TWR-60695

Appendix D
Nozzle Postfire Data

Final Postflight Hardware Evaluation Report 360T021 (RSRM-21, STS-45)

October 1992

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4764

Thiokol CORPORATION
SPACE OPERATIONS

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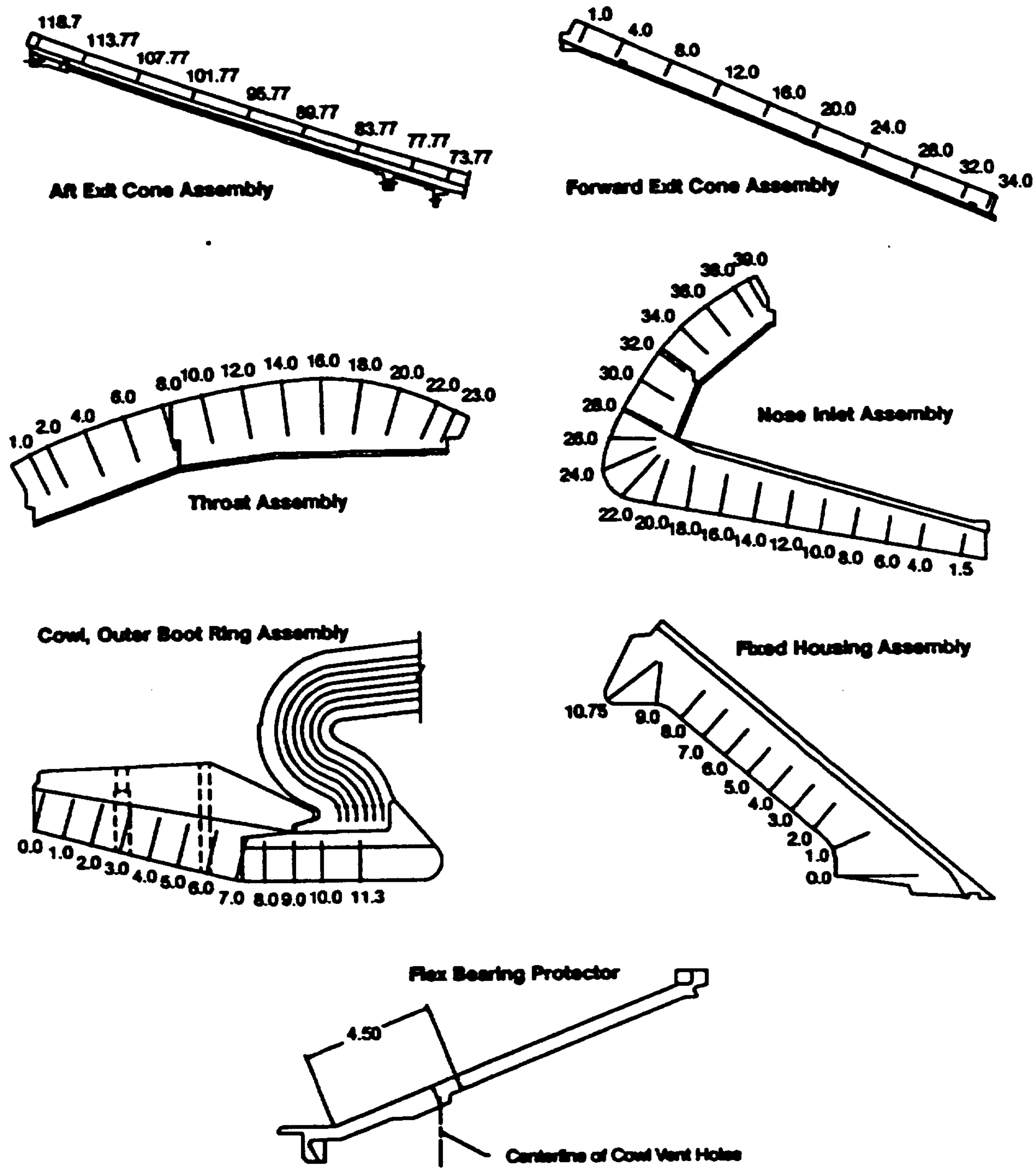

Figure D-1. RSRM Nozzle Liner Char and Erosion Station Locations

Table 1

RSRM-21A Forward Exit Cone (bly Erosion and Char Data

Angular Location	Sta..ons												
0 degrees	0.0	1.0	4.0	4.6	8.0	12.0	16.0	20.0	24.0	28.0	32.0	32.9	34.0	34.5
Measured Erosion		0.34	0.36	0.35										
Measured Char		0.74	0.72	0.74										
Adjusted Char *		0.59	0.58	0.59										
Denomenator		1.32	1.33	1.12										
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.37	0.30	0.26										
90 degrees														
Measured Erosion		0.32	0.31	0.30	0.32									
Measured Char		0.72	0.73	0.76	0.74									
Adjusted Char *		0.58	0.58	0.61	0.59									
Denomenator		1.26	1.26	1.06	1.28									
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.43	0.38	0.33	0.27									
180 degrees														
Measured Erosion		0.34	0.34	0.36										
Measured Char		0.70	0.68	0.66										
Adjusted Char *		0.56	0.54	0.53										
Denomenator		1.28	1.26	1.07										
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.41	0.38	0.32										
270 degrees														
Measured Erosion		0.37	0.38											
Measured Char		0.69	0.73											
Adjusted Char *		0.55	0.58											
Denomenator		1.32	1.38											
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.37	0.26											

Minimum margin of safety is 0.26 at station 4.00 degree 270.00
Maximum margin of safety is 0.43 at station 1.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 2

RSRM-21B Forward Exit Cone ...ly Erosion and Char Data

Angular Location	Stations													
0 degrees	0.0	1.0	4.0	4.6	8.0	12.0	16.0	20.0	24.0	28.0	32.0	32.9	34.0	34.5
Measured Erosion		0.35	0.36	0.35						0.27	0.27	0.22	0.19	
Measured Char		0.72	0.71	0.74						0.65	0.61	0.63	0.65	
Adjusted Char *		0.58	0.57	0.59						0.52	0.49	0.50	0.52	
Denomenator		1.31	1.32	1.12						1.11	1.07	0.83	0.97	
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.37	0.31	0.26						0.20	0.28	0.35	0.45	
90 degrees														
Measured Erosion		0.37	0.36	0.35							0.25	0.21		
Measured Char		0.73	0.76	0.75							0.77	0.78		
Adjusted Char *		0.58	0.61	0.60							0.62	0.62		
Denomenator		1.36	1.37	1.13							1.20	0.94		
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.33	0.26	0.25							0.15	0.20		
180 degrees														
Measured Erosion		0.36	0.35	0.35										
Measured Char		0.70	0.71	0.72										
Adjusted Char *		0.56	0.57	0.58										
Denomenator		1.31	1.30	1.10										
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.38	0.33	0.28										
270 degrees														
Measured Erosion		0.37	0.35	0.37							0.23	0.22		
Measured Char		0.72	0.70	0.67							0.69	0.70		
Adjusted Char *		0.58	0.56	0.54							0.55	0.56		
Denomenator		1.35	1.29	1.09							1.08	0.89		
RSRM Liner Thickness		1.807	1.731	1.411	1.629	1.524	1.426	1.356	1.322	1.328	1.372	1.127	1.408	
Margin of Safety		0.34	0.34	0.29							0.27	0.27		

Minimum margin of safety is 0.15 at station 32.00 degree 90.00
Maximum margin of safety is 0.45 at station 34.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 3
RSRM-21A Throat Asse rosion and Char Data

Angular Location	St ons													
	0.0	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
0 degrees														
Measured Erosion			1.10	1.16	1.19	1.20	1.11	1.12	1.11	1.06	0.92	0.71	0.42	0.36
Measured Char			0.70	0.63	0.61	0.54	0.60	0.60	0.62	0.66	0.74	0.75	0.82	0.81
Adjusted Char *			0.53	0.47	0.46	0.41	0.45	0.45	0.47	0.50	0.59	0.60	0.66	0.65
Denominator			2.86	2.91	2.95	2.91	2.78	2.80	2.80	2.74	2.58	2.17	1.66	1.53
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety			0.14	0.14	0.11	0.10	0.22	0.25	0.29	0.35	0.39	0.49	0.56	0.38
90 degrees														
Measured Erosion		1.09	1.09	1.12	1.19	1.16	1.14	1.11	1.08	1.05	0.92	0.72	0.42	0.36
Measured Char		0.59	0.60	0.66	0.62	0.63	0.55	0.60	0.60	0.61	0.65	0.67	0.78	0.83
Adjusted Char *		0.44	0.45	0.50	0.47	0.47	0.41	0.45	0.45	0.46	0.52	0.54	0.62	0.66
Denominator		2.73	2.74	2.86	2.96	2.91	2.80	2.78	2.72	2.67	2.49	2.11	1.62	1.55
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.16	0.18	0.16	0.11	0.09	0.22	0.26	0.33	0.39	0.44	0.53	0.59	0.36
180 degrees														
Measured Erosion		1.03	1.04	1.10	1.18	1.20	1.18	1.13	1.11	1.07	0.91	0.77	0.46	0.39
Measured Char		0.63	0.66	0.64	0.61	0.53	0.56	0.56	0.59	0.59	0.71	0.72	0.89	0.85
Adjusted Char *		0.47	0.50	0.48	0.46	0.40	0.42	0.42	0.44	0.44	0.57	0.58	0.71	0.68
Denominator		2.65	2.70	2.80	2.93	2.90	2.88	2.78	2.77	2.69	2.53	2.26	1.81	1.63
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.20	0.20	0.18	0.12	0.10	0.18	0.26	0.31	0.38	0.42	0.43	0.43	0.29
270 degrees														
Measured Erosion		1.05	1.10	1.13	1.19	1.20	1.14	1.10	1.13	1.08	0.93	0.71	0.48	0.40
Measured Char		0.69	0.68	0.68	0.66	0.60	0.66	0.68	0.61	0.67	0.73	0.78	0.82	0.86
Adjusted Char *		0.52	0.51	0.51	0.50	0.45	0.50	0.51	0.46	0.50	0.58	0.62	0.66	0.69
Denominator		2.75	2.84	2.90	3.00	2.96	2.90	2.84	2.83	2.79	2.59	2.20	1.78	1.66
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.16	0.14	0.14	0.09	0.07	0.17	0.24	0.28	0.33	0.38	0.47	0.45	0.27

Minimum margin of safety is 0.07 at station 8.00 degree 270.00
Maximum margin of safety is 0.59 at station 22.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 4
RSRM-21B Throat Asse   osion and Char Data

Angular Location	Stations 0.0	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
0 degrees														
Measured Erosion		1.03	1.06	1.13	1.18	1.20	1.12	1.10	1.09	1.10	0.95	0.71	0.45	0.39
Measured Char		0.64	0.67	0.59	0.61	0.59	0.58	0.59	0.60	0.57	0.66	0.77	0.80	0.84
Adjusted Char *		0.48	0.50	0.44	0.46	0.44	0.43	0.44	0.45	0.43	0.53	0.62	0.64	0.67
Denomenator		2.66	2.75	2.81	2.93	2.95	2.78	2.75	2.74	2.73	2.56	2.19	1.70	1.62
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.19	0.18	0.18	0.12	0.08	0.22	0.28	0.32	0.36	0.40	0.48	0.52	0.30
90 degrees														
Measured Erosion		1.03	1.05	1.11	1.15	1.19	1.19	1.15	1.12	1.06	0.94	0.73	0.44	0.38
Measured Char		0.59	0.57	0.61	0.63	0.60	0.51	0.58	0.56	0.63	0.68	0.77	0.89	0.83
Adjusted Char *		0.44	0.43	0.46	0.47	0.45	0.38	0.43	0.42	0.47	0.54	0.62	0.71	0.66
Denomenator		2.61	2.63	2.79	2.89	2.94	2.86	2.84	2.77	2.71	2.56	2.23	1.77	1.59
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.21	0.23	0.19	0.13	0.08	0.19	0.24	0.31	0.37	0.40	0.45	0.46	0.33
180 degrees														
Measured Erosion		1.09	1.12	1.17	1.19	1.23	1.16	1.18	1.19	1.11	0.97	0.74	0.42	0.34
Measured Char		0.61	0.63	0.67	0.66	0.58	0.51	0.52	0.59	0.65	0.67	0.74	0.79	0.89
Adjusted Char *		0.46	0.47	0.50	0.50	0.43	0.38	0.39	0.44	0.49	0.54	0.59	0.63	0.71
Denomenator		2.75	2.83	2.97	3.00	3.00	2.80	2.85	2.93	2.83	2.61	2.22	1.63	1.57
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.15	0.15	0.12	0.09	0.06	0.21	0.24	0.24	0.31	0.37	0.46	0.58	0.34
270 degrees														
Measured Erosion		1.04	1.03	1.09	1.15	1.18	1.13	1.13	1.09	1.05	0.94	0.71	0.45	0.36
Measured Char		0.53	0.56	0.57	0.60	0.56	0.54	0.59	0.59	0.58	0.61	0.68	0.71	0.82
Adjusted Char *		0.40	0.42	0.43	0.45	0.42	0.41	0.44	0.44	0.43	0.49	0.54	0.57	0.66
Denomenator		2.58	2.58	2.71	2.86	2.88	2.77	2.81	2.73	2.64	2.49	2.10	1.61	1.54
RSRM Liner Thickness		3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety		0.23	0.26	0.22	0.15	0.10	0.23	0.25	0.33	0.40	0.44	0.54	0.60	0.37

Minimum margin of safety is 0.06 at station 8.00 degree 180.00
Maximum margin of safety is 0.60 at station 22.00 degree 270.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char *}} - 1$$

Table 5

RSRM-21A Nose Inlet Assembly Erosion and Char Dat

Forward Nose Ring and Aft Inlet Ring

Angular Location	Stations										
0 degrees	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	39.0	39.5
Measured Erosion	1.58	1.82	1.34	1.14	0.92	0.95	0.89	0.89	0.95	0.98	
Measured Char	0.83	0.84	0.87	0.67	0.67	0.60	0.56	0.60	0.62	0.62	
Adjusted Char *	0.66	0.67	0.65	0.50	0.50	0.45	0.42	0.45	0.47	0.47	
Denomenator	3.99	4.48	3.50	2.91	2.47	2.46	2.31	2.34	2.48	2.54	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.18	0.05	0.11	0.21	0.32	0.20	0.38	0.37	0.22	0.18	
90 degrees											
Measured Erosion	1.38	1.50	0.99	1.04	0.90	0.97	0.85	0.86	0.92	0.96	
Measured Char	0.75	0.74	0.85	0.68	0.62	0.53	0.51	0.53	0.54	0.57	
Adjusted Char *	0.60	0.59	0.64	0.51	0.47	0.40	0.38	0.40	0.41	0.43	
Denomenator	3.51	3.74	2.78	2.72	2.38	2.44	2.18	2.22	2.35	2.45	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.34	0.25	0.39	0.29	0.37	0.21	0.46	0.44	0.29	0.22	
180 degrees											
Measured Erosion	1.40	1.57	1.09	1.00	0.85	0.93	0.85	0.85	0.92	0.94	
Measured Char	0.62	0.74	0.78	0.75	0.74	0.63	0.62	0.55	0.57	0.57	
Adjusted Char *	0.50	0.59	0.59	0.56	0.56	0.47	0.47	0.41	0.43	0.43	
Denomenator	3.42	3.88	2.91	2.70	2.39	2.45	2.28	2.22	2.37	2.41	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.38	0.21	0.33	0.30	0.36	0.20	0.39	0.44	0.27	0.24	
270 degrees											
Measured Erosion	1.47	1.75	1.27	1.10	0.94	1.00	0.92	0.92	0.96	0.98	
Measured Char	0.79	0.86	0.90	0.66	0.70	0.64	0.60	0.62	0.61	0.61	
Adjusted Char *	0.63	0.69	0.68	0.50	0.53	0.48	0.45	0.47	0.46	0.46	
Denomenator	3.73	4.36	3.38	2.82	2.54	2.60	2.40	2.42	2.49	2.53	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.26	0.08	0.14	0.24	0.28	0.13	0.32	0.32	0.21	0.18	

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 6
RSRM-21B Nose Inlet Assembly Erosion and Char Dat
Forward Nose Ring and Aft Inlet Ring

Angular Location	Stations										
0 degrees	22.0	24.0	26.0	28.0	30.0	32.0	34.0	36.0	38.0	39.0	39.5
Measured Erosion	1.58	1.77	1.35	1.10	0.84	0.91	0.88	0.86	0.91	0.94	
Measured Char	0.69	0.81	0.80	0.63	0.62	0.54	0.50	0.49	0.53	0.57	
Adjusted Char *	0.55	0.65	0.60	0.47	0.47	0.41	0.38	0.37	0.40	0.43	
Denomenator	3.69	4.35	3.45	2.79	2.26	2.33	2.23	2.18	2.32	2.41	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.28	0.08	0.12	0.26	0.44	0.27	0.43	0.47	0.31	0.24	
90 degrees											
Measured Erosion	1.61	1.75	1.21	1.11	0.84	0.92	0.87	0.90	0.96	1.00	
Measured Char	0.74	0.76	0.84	0.67	0.60	0.60	0.59	0.55	0.62	0.63	
Adjusted Char *	0.59	0.61	0.63	0.50	0.45	0.45	0.44	0.41	0.47	0.47	
Denomenator	3.96	4.26	3.21	2.85	2.24	2.40	2.29	2.32	2.50	2.59	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.19	0.10	0.20	0.23	0.45	0.23	0.39	0.38	0.21	0.16	
180 degrees											
Measured Erosion	1.67	1.78	1.22	1.15	0.88	0.90	0.88	0.87	0.94	0.98	
Measured Char	0.79	0.79	0.87	0.60	0.56	0.62	0.52	0.59	0.59	0.64	
Adjusted Char *	0.63	0.63	0.65	0.45	0.42	0.47	0.39	0.44	0.44	0.48	
Denomenator	4.13	4.35	3.26	2.86	2.29	2.38	2.25	2.29	2.43	2.56	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.14	0.08	0.19	0.23	0.42	0.24	0.42	0.40	0.24	0.17	
270 degrees											
Measured Erosion	1.96	1.75	1.27		0.87	0.92	0.90	0.92	0.98	1.02	
Measured Char	0.78	0.87	0.89		0.64	0.59	0.59	0.53	0.56	0.57	
Adjusted Char *	0.62	0.70	0.67		0.48	0.44	0.44	0.40	0.42	0.43	
Denomenator	3.90	4.37	3.37		2.34	2.39	2.35	2.34	2.48	2.57	
RSRM Liner Thickness	4.713	4.691	3.863	3.508	3.252	2.950	3.182	3.200	3.026	3.000	
Margin of Safety	0.21	0.07	0.14		0.39	0.23	0.35	0.37	0.22	0.17	

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^*} - 1$$

Table 7

RSRM-21A Nose Inlet As[sembly] Erosion and Char Data

Stations

Angular Location	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	16.4	16.6	16.9	18.0	20.0
0 degrees													
Measured Erosion		0.30	0.37	0.40	0.42	0.40	0.49	0.75				0.85	0.99
Measured Char		0.74	0.64	0.61	0.61	0.63	0.62	0.49				0.50	0.56
Adjusted Char *		0.59	0.51	0.49	0.49	0.50	0.50	0.39				0.40	0.45
Denomenator		1.34	1.38	1.41	1.45	1.43	1.60	1.99				2.20	2.54
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.52	0.63	0.74	0.84	1.01	0.93	0.66				0.59	0.60
90 degrees													
Measured Erosion		0.33	0.33	0.39	0.43	0.43	0.52	0.64				0.76	0.86
Measured Char		0.65	0.62	0.56	0.54	0.59	0.54	0.49				0.59	0.57
Adjusted Char *		0.52	0.50	0.45	0.43	0.47	0.43	0.39				0.47	0.46
Denomenator		1.31	1.28	1.34	1.40	1.45	1.58	1.77				2.11	2.49
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.56	0.76	0.83	0.91	0.98	0.95	0.86				0.66	0.63
180 degrees													
Measured Erosion		0.31	0.34	0.39	0.40	0.44	0.49	0.63				0.75	0.94
Measured Char		0.69	0.65	0.59	0.55	0.55	0.57	0.43				0.49	0.54
Adjusted Char *		0.55	0.52	0.47	0.44	0.44	0.46	0.34				0.39	0.43
Denomenator		1.31	1.33	1.37	1.35	1.43	1.55	1.69				1.99	2.42
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.56	0.69	0.79	0.98	1.01	0.99	0.95				0.76	0.68
270 degrees													
Measured Erosion		0.36	0.38	0.44	0.47	0.53	0.53	0.68				0.77	0.95
Measured Char		0.64	0.69	0.65	0.59	0.64	0.62	0.60				0.56	0.72
Adjusted Char *		0.51	0.55	0.52	0.47	0.51	0.50	0.48				0.45	0.58
Denomenator		1.36	1.45	1.53	1.53	1.70	1.68	1.96				2.10	2.62
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.50	0.55	0.61	0.74	0.69	0.84	0.68				0.67	0.55

Minimum margin of safety is 0.05 at station 24.00 degree 0.00
Maximum margin of safety is 1.01 at station 12.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 6

RSRM-21B Nose Inlet As[illegible] Erosion and Char Data

Angular Location	Stations												
0 degrees	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	16.4	16.6	16.9	18.0	20.0
Measured Erosion	0.27	0.31	0.34	0.39	0.45	0.50	0.58	0.63				0.73	0.92
Measured Char	0.74	0.61	0.69	0.67	0.58	0.61	0.46	0.52				0.54	0.58
Adjusted Char *	0.50	0.49	0.55	0.54	0.46	0.49	0.37	0.42				0.43	0.46
Denomenator	1.28	1.23	1.37	1.45	1.48	1.61	1.62	1.78				2.00	2.42
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety	0.39	0.66	0.64	0.70	0.80	0.79	0.91	0.85				0.75	0.68
90 degrees													
Measured Erosion		0.39	0.39	0.46	0.50	0.54	0.64	0.70				0.85	1.05
Measured Char		0.58	0.66	0.64	0.59	0.61	0.52	0.53				0.56	0.65
Adjusted Char *		0.46	0.53	0.51	0.47	0.49	0.42	0.42				0.45	0.52
Denomenator		1.36	1.44	1.56	1.59	1.69	1.80	1.93				2.26	2.75
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.50	0.56	0.58	0.68	0.70	0.72	0.71				0.55	0.47
180 degrees													
Measured Erosion		0.39	0.42	0.50	0.52	0.61	0.69	0.78				0.85	1.11
Measured Char		0.58	0.60	0.54	0.55	0.58	0.55	0.55				0.60	0.61
Adjusted Char *		0.46	0.48	0.43	0.44	0.46	0.44	0.44				0.48	0.49
Denomenator		1.36	1.44	1.54	1.59	1.80	1.93	2.11				2.30	2.83
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.50	0.56	0.60	0.68	0.60	0.60	0.56				0.52	0.43
270 degrees													
Measured Erosion		0.34	0.40	0.45	0.50	0.57	0.66	0.71				0.82	1.05
Measured Char		0.61	0.61	0.65	0.59	0.57	0.47	0.50				0.52	0.63
Adjusted Char *		0.49	0.49	0.52	0.47	0.46	0.38	0.40				0.42	0.50
Denomenator		1.29	1.41	1.55	1.59	1.71	1.79	1.92				2.16	2.73
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298				3.507	4.055
Margin of Safety		0.50	0.59	0.59	0.68	0.68	0.73	0.72				0.62	0.49

Minimum margin of safety is 0.07 at station 24.00 degree 270.00
Maximum margin of safety is 0.91 at station 14.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char *}} - 1$$

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Angular Lo...	...ions											
0 degrees	0.3	1	2	3	4	5	6**	6.8**	8**	9	10	11.3
Measured Erosion	0.16	0.20	0.25	0.28	NA	NA	NA	NA	NA	0.00	0.00	0.00
Measured Char	0.77	0.79	0.80	0.88	NA	NA	NA	NA	NA	0.83	0.86	0.85
Adjusted Char *	0.62	0.63	0.64	0.70	NA	NA	NA	NA	NA	0.66	0.69	0.68
2E + 1.25AC	1.09	1.19	1.30	1.44	NA	NA	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	NA	1.00	1.03	1.02
Total Affected Depth	----	----	----	----	----	----	1.05	NA	1.00	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.32	0.26	0.21	0.15	NA	NA	0.20	NA	0.07	0.68	0.63	0.67
90 degrees												
Measured Erosion	0.23	0.27	0.32	0.32	0.27	NA	NA	NA	NA	0.01	0.02	0.02
Measured Char	0.67	0.65	0.68	0.69	0.72	NA	NA	NA	NA	0.82	0.84	0.88
Adjusted Char *	0.54	0.52	0.54	0.55	0.58	NA	NA	NA	NA	0.66	0.67	0.70
2E + 1.25AC	1.13	1.19	1.32	1.33	1.26	NA	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	NA	1.00	1.04	1.09
Total Affected Depth	----	----	----	----	----	----	0.98	1.08	0.85	0.98	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.27	0.26	0.19	0.24	0.38	NA	0.29	0.20	0.25	0.68	0.63	0.57
165 degrees												
Measured Erosion	0.24	0.29	0.33	0.35	0.34	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.69	0.62	0.64	0.64	0.64	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.55	0.50	0.51	0.51	0.51	NA	NA	NA	NA	NA	NA	NA
2E + 1.25AC	1.17	1.20	1.30	1.34	1.32	NA	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	NA	NA	NA	NA
Total Affected Depth	----	----	----	----	----	----	1.11	----	----	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.23	0.25	0.21	0.24	0.31	NA	0.13	NA	NA	NA	NA	NA

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2 \times \text{erosion} + 1.25 \times \text{adj char*}} - 1 \qquad \text{(Stations 0.3 through 5)}$$

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.5 \times (\text{erosion} + \text{adj char*})} - 1 \qquad \text{(Stations 6 through 11.3)}$$

** PMS calculations made with total heat affected or wedgeout depth (not adjusted to end of action time)

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.5 \times (\text{total affected depth})} - 1$$

Table 10

360T021B Cowl/OBR Erosion and Char Data

Angular Location	Stations											
	0.3	1	2	3	4	5	6**	6.8	8	9	10	11.3
0 degrees												
Measured Erosion	0.26	0.30	0.29	0.33	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	0.62	0.65	0.71	0.68	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	0.50	0.52	0.57	0.54	NA	NA	NA	NA	NA	NA	NA	NA
2E + 1.25AC	1.14	1.25	1.29	1.34	NA	NA	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	NA	NA	NA	NA
Total Affected Depth	----	----	----	----	----	----	1.01	----	----	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.26	0.20	0.22	0.24	NA	NA	0.25	NA	NA	NA	NA	NA
90 degrees												
Measured Erosion	0.30	0.36	0.38	0.38	NA	NA	NA	NA	0.03	0.03	0.01	0.00
Measured Char	0.63	0.65	0.66	0.61	NA	NA	NA	NA	0.90	0.80	0.74	0.77
Adjusted Char *	0.50	0.52	0.53	0.49	NA	NA	NA	NA	0.72	0.64	0.59	0.62
2E + 1.25AC	1.23	1.37	1.42	1.37	NA	NA	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	1.13	1.01	0.90	0.92
Total Affected Depth	----	----	----	----	----	----	1.00	----	----	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.17	0.09	0.11	0.21	NA	NA	0.26	NA	0.42	0.67	0.87	0.84
180 degrees												
Measured Erosion	0.29	0.32	0.34	0.37	0.37	0.36	NA	NA	0.01	0.00	0.00	0.00
Measured Char	0.68	0.69	0.71	0.76	0.72	0.70	NA	NA	0.87	0.85	0.82	0.79
Adjusted Char *	0.54	0.55	0.57	0.61	0.58	0.56	NA	NA	0.70	0.68	0.66	0.63
2E + 1.25AC	1.26	1.33	1.39	1.50	1.46	1.42	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	1.06	1.02	0.98	0.95
Total Affected Depth	----	----	----	----	----	----	1.09	0.97	----	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.14	0.13	0.13	0.10	0.19	0.28	0.16	0.34	0.51	0.64	0.71	0.80
270 degrees												
Measured Erosion	0.29	0.34	0.37	0.37	0.37	0.33	NA	NA	0.05	0.05	0.05	0.02
Measured Char	0.66	0.67	0.71	0.72	0.67	0.65	NA	NA	0.84	0.76	0.68	0.91
Adjusted Char *	0.53	0.54	0.57	0.58	0.54	0.52	NA	NA	0.67	0.61	0.54	0.73
2E + 1.25AC	1.24	1.35	1.45	1.46	1.41	1.31	----	----	----	----	----	----
1.5(E + AC)	----	----	----	----	----	----	NA	NA	1.08	0.99	0.89	1.12
Total Affected Depth	----	----	----	----	----	----	0.98	0.96	----	----	----	----
RSRM Min Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.16	0.11	0.09	0.13	0.23	0.38	0.29	0.35	0.48	0.70	0.89	0.52

Table 10

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2 \times \text{erosion} + 1.25 \times \text{adj char*}} - 1 \qquad \text{(Stations 0.3 through 5)}$$

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.5 \times (\text{erosion} + \text{adj char*})} - 1 \qquad \text{(Stations 6 through 11.3)}$$

** PMS calculations made with total heat affected or wedgeout depth (not adjusted to end of action time)

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.5 \times (\text{total affected depth})} - 1$$

Table II

RSRM-21A Fixed Housing A Erosion and Char Data

Angular Location	Stations 0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75	11.00
0 degrees												
Measured Erosion	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Measured Char	1.14	1.07	1.00	0.98	0.93	0.91	0.91	0.89	0.84	0.83		
Adjusted Char *	0.91	0.86	0.80	0.78	0.74	0.73	0.73	0.71	0.67	0.66		
Denomenator	1.24	1.07	1.00	0.98	0.93	0.91	0.91	0.89	0.84	0.83		
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.07	0.94	0.82	0.86	0.97	1.01	1.01	1.06	1.19	1.92		
90 degrees												
Measured Erosion	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Measured Char	1.32	1.08	1.08	1.11	1.09	1.03	0.99	0.98	0.88	0.86		
Adjusted Char *	1.06	0.86	0.86	0.89	0.87	0.82	0.79	0.78	0.70	0.69		
Denomenator	1.38	1.08	1.08	1.11	1.09	1.03	0.99	0.98	0.88	0.86		
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	1.76	0.93	0.69	0.65	0.68	0.78	0.85	0.87	1.09	1.82		
180 degrees												
Measured Erosion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	
Measured Char	1.04	0.92	0.88	0.86	0.88	0.86	0.81	0.81	0.75	0.74	1.17	
Adjusted Char *	0.83	0.74	0.70	0.69	0.70	0.69	0.65	0.65	0.60	0.59	0.94	
Denomenator	1.04	0.92	0.88	0.86	0.88	0.86	0.81	0.81	0.75	0.74	2.59	
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.66	1.26	1.07	1.12	1.08	1.13	1.26	1.26	1.45	2.28	0.18	
270 degrees												
Measured Erosion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	
Measured Char	1.23	1.08	1.06	1.02	1.00	1.02	1.02	1.02	0.89	0.83	1.28	
Adjusted Char *	0.98	0.86	0.85	0.82	0.80	0.82	0.82	0.82	0.71	0.66	1.02	
Denomenator	1.23	1.08	1.06	1.02	1.00	1.02	1.02	1.02	0.89	0.83	2.24	
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.10	0.93	0.72	0.79	0.83	0.80	0.80	0.80	1.06	1.92	0.36	

Minimum margin of safety is 0.18 at station 10.75 degree 180.00
Maximum margin of safety is 2.66 at station 0.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

Table 12
RSRM-21B Fixed Housing A Erosion and Char Data

Angular Location	Stations										
0 degrees	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75	11.00
Measured Erosion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	
Measured Char	1.15	1.05	0.95	0.97	0.99	0.98	0.98	1.00	0.90	0.95	0.93	
Adjusted Char *	0.92	0.84	0.76	0.78	0.79	0.78	0.78	0.80	0.72	0.76	0.74	
Denomenator	1.15	1.05	0.95	0.97	0.99	0.98	0.98	1.00	0.90	0.95	1.23	
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.31	0.98	0.92	0.88	0.85	0.87	0.87	0.83	1.04	1.55	1.48	
90 degrees												
Measured Erosion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	
Measured Char	1.12	1.05	1.04	1.03	0.99	0.97	0.99	0.97	0.89	0.80	1.58	
Adjusted Char *	0.90	0.84	0.83	0.82	0.79	0.78	0.79	0.78	0.71	0.64	1.26	
Denomenator	1.12	1.05	1.04	1.03	0.99	0.97	0.99	0.97	0.89	0.80	2.36	
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.40	0.98	0.75	0.77	0.85	0.89	0.85	0.89	1.06	2.03	0.29	
180 degrees												
Measured Erosion	0.07	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Measured Char	1.14	1.07	0.98	0.91	0.93	0.96	0.97	0.95	0.74	0.76		
Adjusted Char *	0.91	0.86	0.78	0.73	0.74	0.77	0.78	0.76	0.59	0.61		
Denumenator	1.28	1.11	0.98	0.91	0.93	0.96	0.97	0.95	0.74	0.76		
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	1.97	0.87	0.86	1.01	0.97	0.91	0.89	0.93	1.48	2.19		
270 degrees												
Measured Erosion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	
Measured Char	1.26	1.19	1.06	1.09	1.07	1.08	1.07	1.02	0.95	0.75	1.36	
Adjusted Char *	1.01	0.95	0.85	0.87	0.86	0.86	0.86	0.82	0.76	0.60	1.09	
Denomenator	1.26	1.19	1.06	1.09	1.07	1.08	1.07	1.02	0.95	0.75	2.48	
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048	
Margin of Safety	2.02	0.75	0.72	0.68	0.71	0.70	0.71	0.80	0.93	2.23	0.23	

Minimum margin of safety is 0.23 at station 10.75 degree 270.00
Maximum margin of safety is 2.40 at station 0.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

SPACE SHUTTLE
Solid Rocket Motor
Thiokol Corporation

TWR-60695
Revision B

Appendix E
Insulation Postfire Data

Final Postflight Hardware Evaluation Report
360T021 (RSRM-21, STS-45)

August 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
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Thiokol CORPORATION
SPACE OPERATIONS

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TABLE 1

RSRM-21A NOZZLE TO CASE JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
0.0	5.610	4.618	0.992	4.9	5.7
21.6	5.608	4.783	0.825	5.9	6.8
46.8	5.599	4.505	1.094	4.5	5.1
68.4	5.583	5.025	0.558	8.0	10.0
90.0	5.565	5.090	0.475	10.3	11.7
111.6	5.595	5.024	0.571	8.6	9.8
136.8	5.591	5.025	0.566	8.7	9.9
158.4	5.598	4.854	0.744	6.6	7.5
180.0	5.600	4.290	1.310	3.7	4.3
201.6	5.582	4.630	0.952	5.1	5.9
226.8	5.598	4.556	1.042	4.7	5.4
248.4	5.592	4.818	0.774	6.3	7.2
270.0	5.586	4.887	0.699	7.0	8.0
291.6	5.592	4.898	0.694	7.1	8.1
316.8	5.597	5.010	0.587	8.3	9.5
338.4	5.591	5.000	0.591	8.3	9.5
	MEDIAN	MEDIAN	MEDIAN	MINIMUM	MINIMUM
	5.594	4.871	0.721	3.7	4.3

A SAFETY FACTOR OF 2.0 IS REQUIRED

Table 2

RSRM-21A AFT FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.738	2.307	0.431	6.0	6.4
16.0	2.721	2.364	0.357	7.3	7.6
30.0	2.749	2.346	0.403	6.4	6.8
46.0	2.755	2.291	0.464	5.6	5.9
60.0	2.764	2.269	0.495	5.2	5.6
76.0	2.770	2.289	0.481	5.4	5.8
90.0	2.716	2.291	0.425	6.1	6.4
106.0	2.762	2.250	0.512	5.1	5.4
120.0	2.759	2.297	0.462	5.6	6.0
136.0	2.745	2.278	0.467	5.6	5.9
150.0	2.759	2.248	0.511	5.1	5.4
166.0	2.746	2.353	0.393	6.6	7.0
180.0	2.735	2.356	0.379	6.8	7.2
196.0	2.735	2.286	0.449	5.8	6.1
210.0	2.725	2.288	0.437	5.9	6.2
226.0	2.731	2.296	0.435	6.0	6.3
242.0	2.730	2.314	0.416	6.2	6.6
256.0	2.732	2.319	0.413	6.3	6.6
270.0	2.740	2.348	0.392	6.6	7.0
286.0	2.739	2.313	0.426	6.1	6.4
300.0	2.738	2.362	0.376	6.9	7.3
316.0	2.732	2.343	0.389	6.7	7.0
330.0	2.734	2.318	0.416	6.2	6.6
346.0	2.736	2.343	0.393	6.6	7.0
	MEDIAN 2.738	MEDIAN 2.310	MEDIAN 0.426	MINIMUM 5.1	MINIMUM 5.4

A SAFETY FACTOR OF 2.0 IS REQUIRED

TABLE 3

RSRM-21A CENTER FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.782	2.553	0.229	11.3	12.1
16.0	2.783	2.525	0.258	10.1	10.8
30.0	2.785	2.528	0.257	10.1	10.8
46.0	2.788	2.555	0.233	11.1	12.0
60.0	2.789	2.582	0.207	12.5	13.5
76.0	2.790	2.619	0.171	15.2	16.3
90.0	2.750	2.551	0.199	13.0	13.8
106.0	2.800	2.516	0.284	9.1	9.9
120.0	2.782	2.529	0.253	10.3	11.0
136.0	2.785	2.523	0.262	9.9	10.6
150.0	2.783	2.518	0.265	9.8	10.5
166.0	2.787	2.550	0.237	10.9	11.8
180.0	2.785	2.540	0.245	10.6	11.4
196.0	2.757	2.577	0.180	14.4	15.3
210.0	2.755	2.568	0.187	13.9	14.7
226.0	2.754	2.568	0.186	14.0	14.8
242.0	2.755	2.575	0.180	14.4	15.3
256.0	2.757	2.589	0.168	15.4	16.4
270.0	2.750	2.583	0.167	15.5	16.5
286.0	2.755	2.602	0.153	17.0	18.0
300.0	2.748	2.588	0.160	16.2	17.2
316.0	2.755	2.602	0.153	17.0	18.0
330.0	2.757	2.588	0.169	15.4	16.3
346.0	2.760	2.555	0.205	12.7	13.5
	MEDIAN 2.771	MEDIAN 2.562	MEDIAN 0.202	MINIMUM 9.1	MINIMUM 9.9

A SAFETY FACTOR OF 2.0 IS REQUIRED

TABLE 4

RSRM-21A FORWARD FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.768	2.650	0.118	22.0	23.5
16.0	2.762	2.586	0.176	14.7	15.7
30.0	2.770	2.574	0.196	13.2	14.1
46.0	2.790	2.631	0.159	16.3	17.5
60.0	2.761	2.579	0.182	14.3	15.2
76.0	2.765	2.580	0.185	14.0	14.9
90.0	2.713	2.638	0.075	34.6	36.2
106.0	2.722	2.639	0.083	31.3	32.8
120.0	2.730	2.610	0.120	21.6	22.7
136.0	2.772	2.595	0.177	14.7	15.7
150.0	2.750	2.635	0.115	22.6	23.9
166.0	2.752	2.654	0.098	26.5	28.1
180.0	2.745	2.585	0.160	16.2	17.2
196.0	2.742	2.595	0.147	17.7	18.7
210.0	2.750	2.585	0.165	15.7	16.7
226.0	2.725	2.591	0.134	19.4	20.3
242.0	2.727	2.579	0.148	17.5	18.4
256.0	2.740	2.580	0.160	16.2	17.1
270.0	2.740	2.635	0.105	24.7	26.1
286.0	2.729	2.612	0.117	22.2	23.3
300.0	2.745	2.628	0.117	22.2	23.5
316.0	2.729	2.656	0.073	35.5	37.4
330.0	2.725	2.575	0.150	17.3	18.2
346.0	2.727	2.602	0.125	20.8	21.8
	MEDIAN 2.743	MEDIAN 2.599	MEDIAN 0.140	MINIMUM 13.2	MINIMUM 14.1

A SAFETY FACTOR OF 2.0 IS REQUIRED

Table 5

RSRM-21A AFT DOME INSULATION PERFORMANCE

PART NO. 1U76668-02
SERIAL NO. 0000012

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
9.3	5.187	5.202	5.066	5.198	5.176	5.185	5.156	5.256	5.066	5.186	4.900
10.7	4.986	4.988	4.962	5.043	4.988	4.976	5.018	5.038	4.962	4.988	4.700
12.0	4.813	4.810	4.790	4.889	4.826	4.792	4.857	4.809	4.790	4.812	4.500
13.1	4.608	4.627	4.608	4.744	4.630	4.604	4.666	4.618	4.604	4.622	4.300
14.4	4.337	4.344	4.367	4.427	4.354	4.323	4.387	4.308	4.308	4.349	4.100
16.0	4.102	4.118	4.108	4.187	4.106	4.070	4.139	4.061	4.061	4.107	3.780
17.3	3.970	3.980	4.011	4.019	3.966	3.942	4.021	3.920	3.920	3.975	3.560
18.5	3.783	3.831	3.850	3.882	3.786	3.782	3.869	3.758	3.758	3.809	3.360
19.5	3.647	3.683	3.695	3.692	3.643	3.622	3.697	3.613	3.613	3.665	3.150
21.3	3.449	3.503	3.498	3.479	3.449	3.419	3.489	3.436	3.419	3.464	2.940
24.3	3.396	3.434	3.464	3.461	3.455	3.441	3.457	3.345	3.345	3.448	2.940
33.0	3.490	3.502	3.616	3.588	3.560	3.515	3.605	3.553	3.490	3.556	3.200
45.0	2.771	2.731	2.780	2.802	2.764	2.801	2.799	2.802	2.731	2.789	2.600
53.0	3.624	3.695	3.631	3.806	3.645	3.718	3.713	3.651	3.624	3.673	3.380
56.0	3.241	3.306	3.340	3.472	3.287	3.348	3.336	3.301	3.241	3.321	2.790
72.0	2.173	2.069	2.106	2.071	2.096	2.058	2.107	2.086	2.058	2.091	2.000
75.0	1.880	1.924	1.906	1.968	1.920	1.903	1.887	1.928	1.880	1.913	1.800
78.0	1.730	1.698	1.719	1.719	1.670	1.642	1.660	1.690	1.642	1.694	1.600

PART NO. 1U76957-03
SERIAL NO 0000007

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
9.3	4.210	4.193	4.226	4.096	3.979	4.274	4.301	4.362	3.979	4.233
10.7	4.097	4.117	4.055	3.669	3.768	3.945	4.257	4.327	3.669	4.076
12.0	4.337	3.881	3.850	3.553	3.609	3.730	3.944	3.964	3.553	3.865
13.1	3.749	3.701	3.756	3.477	3.488	3.603	3.739	3.842	3.477	3.720
14.4	3.619	3.529	3.546	3.287	3.265	3.387	3.578	3.548	3.265	3.538
16.0	3.409	3.333	3.339	3.130	3.068	3.260	3.415	3.450	3.068	3.336
17.3	3.359	3.285	3.338	3.088	3.046	3.187	3.387	3.345	3.046	3.312
18.5	3.314	3.303	3.320	3.096	3.011	3.184	3.381	3.329	3.011	3.309
19.5	3.182	3.152	3.270	3.128	2.639	3.044	3.285	3.259	2.639	3.167
21.3	3.020	3.101	3.055	2.945	2.872	2.879	3.083	3.075	2.872	3.038
24.3	2.884	3.040	3.030	2.813	2.801	2.771	2.859	2.880	2.771	2.870
33.0	2.308	2.229	2.334	2.270	2.369	2.285	2.358	2.239	2.229	2.297
45.0	1.648	1.682	1.650	1.761	1.878	1.716	1.659	1.743	1.648	1.699
53.0	2.638	2.908	2.639	2.926	2.842	2.695	2.677	2.700	2.638	2.697
56.0	2.426	2.742	2.549	2.787	2.652	2.586	2.582	2.596	2.426	2.591
72.0	1.625	1.657	1.632	1.639	1.667	1.656	1.629	1.615	1.615	1.636
75.0	1.463	1.539	1.496	1.522	1.482	1.506	1.447	1.494	1.447	1.495
78.0	1.253	1.335	1.307	1.291	1.243	1.304	1.252	1.261	1.243	1.276

Table 5

RSRM-21A AFT DOME INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MEDIAN	MAX.	DESIGN M+3S
9.3	0.947	1.009	0.840	1.102	1.197	0.911	0.855	0.894	0.929	1.197	2.560
10.7	0.889	0.871	0.907	1.374	1.220	1.031	0.761	0.711	0.898	1.374	2.261
12.0	0.476	0.929	0.940	1.336	1.217	1.062	0.913	0.845	0.934	1.336	2.208
13.1	0.859	0.926	0.852	1.267	1.142	1.001	0.927	0.776	0.926	1.267	2.218
14.4	0.718	0.815	0.821	1.140	1.089	0.936	0.809	0.760	0.818	1.140	2.225
16.0	0.693	0.785	0.769	1.057	1.038	0.810	0.724	0.611	0.777	1.057	1.980
17.3	0.611	0.695	0.673	0.931	0.920	0.755	0.634	0.575	0.684	0.931	1.675
18.5	0.469	0.528	0.530	0.786	0.775	0.598	0.488	0.429	0.529	0.786	1.496
19.5	0.465	0.531	0.425	0.564	1.004	0.578	0.412	0.354	0.498	1.004	1.617
21.3	0.429	0.402	0.443	0.534	0.577	0.540	0.406	0.361	0.436	0.577	1.654
24.3	0.512	0.394	0.434	0.648	0.654	0.670	0.598	0.465	0.555	0.670	1.832
33.0	1.182	1.273	1.282	1.318	1.191	1.230	1.247	1.314	1.260	1.318	1.399
45.0	1.123	1.049	1.130	1.041	0.886	1.085	1.140	1.059	1.072	1.140	1.222
53.0	0.986	0.787	0.992	0.880	0.803	1.023	1.036	0.951	0.969	1.036	1.305
56.0	0.815	0.564	0.791	0.685	0.635	0.762	0.754	0.705	0.730	0.815	1.369
72.0	0.548	0.412	0.474	0.432	0.429	0.402	0.478	0.471	0.451	0.548	0.817
75.0	0.417	0.385	0.410	0.446	0.438	0.397	0.440	0.434	0.425	0.446	0.773
78.0	0.477	0.363	0.412	0.428	0.427	0.338	0.408	0.429	0.419	0.477	0.718

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS AVE.	EXPOSURE TIME
9.3	7.0	8.1	6.8	8.9	9.6	7.3	6.9	7.2	7.8	124.1
10.7	7.3	7.1	7.4	11.3	10.0	8.5	6.2	5.8	8.0	121.9
12.0	6.0	7.8	7.9	11.2	10.2	8.9	7.7	7.1	8.1	118.8
13.1	7.4	8.0	7.3	10.9	9.8	8.6	8.0	6.7	8.4	116.0
14.4	6.3	7.2	7.3	10.1	9.6	8.3	7.2	6.7	7.8	113.1
16.0	6.3	7.1	7.0	9.6	9.4	7.4	6.6	5.5	7.4	110.1
17.3	5.7	6.5	6.3	8.7	8.6	7.0	5.9	5.4	6.8	107.1
18.5	4.5	5.0	5.1	7.5	7.4	5.7	4.7	4.1	5.5	104.8
19.5	4.5	5.2	4.1	5.5	9.8	5.6	4.0	3.4	5.3	102.8
21.3	4.3	4.0	4.5	5.4	5.8	5.4	4.1	3.6	4.6	99.4
24.3	5.4	4.1	4.6	6.8	6.9	7.0	6.3	4.9	5.7	95.3
33.0	13.9	15.0	15.1	15.5	14.0	14.5	14.7	15.5	14.8	85.0
45.0	14.7	13.8	14.8	13.7	11.6	14.2	15.0	13.9	14.0	76.2
53.0	13.0	10.4	13.1	11.6	10.6	13.5	13.7	12.5	12.3	75.8
56.0	10.8	7.5	10.5	9.1	8.4	10.1	10.0	9.3	9.4	75.6
72.0	9.5	7.2	8.3	7.5	7.5	7.0	8.3	8.2	7.9	57.4
75.0	8.1	7.5	8.0	8.7	8.5	7.7	8.5	8.4	8.2	51.5
78.0	10.1	7.7	8.7	9.1	9.0	7.2	8.6	9.1	8.7	47.2

MOTOR ACTION TIME = 124.9 SECONDS

Table 5

RSRM-21A AFT DOME INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
9.3	5.17	4.86	5.83	4.45	4.09	5.38	5.73	5.48	4.09	180.0	1.5
10.7	5.29	5.40	5.18	3.42	3.85	4.56	6.18	6.61	3.42	136.8	1.5
12.0	9.45	4.84	4.79	3.37	3.70	4.24	4.93	5.33	3.37	136.8	1.5
13.1	5.01	4.64	5.05	3.39	3.77	4.30	4.64	5.54	3.39	136.8	1.5
14.4	5.71	5.03	4.99	3.60	3.76	4.38	5.07	5.39	3.60	136.8	1.5
16.0	5.45	4.82	4.92	3.58	3.64	4.67	5.22	6.19	3.58	136.8	1.5
17.3	5.83	5.12	5.29	3.82	3.87	4.72	5.62	6.19	3.82	136.8	1.5
18.5	7.16	6.36	6.34	4.27	4.34	5.62	6.89	7.83	4.27	136.8	1.5
19.5	6.77	5.93	7.41	5.59	3.14	5.45	7.65	8.90	3.14	180.0	1.5
21.3	6.85	7.31	6.64	5.51	5.10	5.44	7.24	8.14	5.10	180.0	1.5
24.3	5.74	7.46	6.77	4.54	4.50	4.39	4.92	6.32	4.39	226.8	1.5
33.0	2.71	2.51	2.50	2.43	2.69	2.60	2.57	2.44	2.43	136.8	1.5
45.0	2.32	2.48	2.30	2.50	2.93	2.40	2.28	2.46	2.28	270.0	1.5
53.0	3.43	4.29	3.41	3.84	4.21	3.30	3.26	3.55	3.26	270.0	1.5
56.0	3.42	4.95	3.53	4.07	4.39	3.66	3.70	3.96	3.42	0.0	2.0
72.0	3.65	4.85	4.22	4.63	4.66	4.98	4.18	4.25	3.65	0.0	1.5
75.0	4.32	4.68	4.39	4.04	4.11	4.53	4.09	4.15	4.04	136.8	1.5
78.0	3.35	4.41	3.88	3.74	3.75	4.73	3.92	3.73	3.35	0.0	1.5

SEGMENT MINIMUM = 2.28 AT THE 45.0 INCH STATION

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
9.3	5.48	5.16	6.03	4.72	4.32	5.69	6.03	5.88	4.32	180.0	1.5
10.7	5.61	5.73	5.47	3.67	4.09	4.83	6.59	7.09	3.67	136.8	1.5
12.0	10.11	5.18	5.10	3.66	3.97	4.51	5.32	5.69	3.66	136.8	1.5
13.1	5.36	5.00	5.41	3.74	4.05	4.60	5.03	5.95	3.74	136.8	1.5
14.4	6.04	5.33	5.32	3.88	4.00	4.62	5.42	5.67	3.88	136.8	1.5
16.0	5.92	5.25	5.34	3.96	3.96	5.02	5.72	6.65	3.96	180.0	1.5
17.3	6.50	5.73	5.96	4.32	4.31	5.22	6.34	6.82	4.31	180.0	1.5
18.5	8.07	7.26	7.26	4.94	4.89	6.32	7.93	8.76	4.89	180.0	1.5
19.5	7.84	6.94	8.69	6.55	3.63	6.27	8.97	10.21	3.63	180.0	1.5
21.3	8.04	8.71	7.90	6.51	5.98	6.33	8.59	9.52	5.98	180.0	1.5
24.3	6.63	8.72	7.98	5.34	5.28	5.14	5.78	7.19	5.14	226.8	1.5
33.0	2.95	2.75	2.82	2.72	2.99	2.86	2.89	2.70	2.70	316.8	1.5
45.0	2.47	2.60	2.46	2.69	3.12	2.58	2.46	2.65	2.46	270.0	1.5
53.0	3.68	4.70	3.66	4.33	4.54	3.63	3.58	3.84	3.58	270.0	1.5
56.0	3.98	5.86	4.22	5.07	5.18	4.39	4.42	4.68	3.98	0.0	2.0
72.0	3.97	5.02	4.44	4.79	4.89	5.12	4.41	4.43	3.97	0.0	1.5
75.0	4.51	5.00	4.65	4.41	4.38	4.79	4.29	4.44	4.29	270.0	1.5
78.0	3.63	4.68	4.17	4.02	3.91	4.86	4.07	3.94	3.63	0.0	1.5

SEGMENT MINIMUM = 2.46 AT THE 45.0 INCH STATION

Table 6
RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76668-02
SERIAL NO. 0000012

STATION	DEGREE LOCATIONS										
(IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
85.0	1.506	1.502	1.510	1.584	1.541	1.525	1.509	1.524	1.502	1.517	1.300
90.0	1.431	1.432	1.453	1.403	1.456	1.409	1.392	1.422	1.392	1.427	1.265
98.0	1.382	1.368	1.432	1.424	1.384	1.398	1.398	1.394	1.368	1.396	1.135
105.8	1.077	1.162	1.090	1.117	1.092	1.088	1.070	1.078	1.070	1.089	1.080
116.0	1.074	1.122	1.065	1.061	1.111	1.097	1.094	1.084	1.061	1.089	1.050
124.5	1.029	1.072	1.029	1.046	1.027	1.027	1.068	1.031	1.027	1.030	1.030
133.0	1.088	1.161	1.097	1.070	1.076	1.094	1.118	1.078	1.070	1.091	0.980
145.5	0.930	0.924	0.913	0.918	0.923	0.924	0.918	0.920	0.913	0.922	0.930
158.5	0.896	0.891	0.878	0.882	0.879	0.910	0.900	0.887	0.878	0.889	0.880
166.0	1.000	1.029	0.970	0.977	0.988	1.017	0.960	0.988	0.960	0.988	0.850
177.7	1.540	1.526	1.541	1.461	1.484	1.461	1.510	1.444	1.444	1.497	1.000
192.5	0.911	0.952	0.859	0.885	0.900	0.910	0.918	0.916	0.859	0.911	0.780
202.5	0.752	0.742	0.714	0.723	0.729	0.740	0.733	0.727	0.714	0.731	0.730
214.0	0.715	0.712	0.690	0.690	0.702	0.713	0.693	0.706	0.690	0.704	0.700
227.3	0.736	0.760	0.781	0.755	0.775	0.780	0.814	0.751	0.736	0.767	0.650
238.3	0.651	0.643	0.630	0.630	0.636	0.632	0.635	0.636	0.630	0.636	0.630
250.0	0.568	0.559	0.550	0.558	0.553	0.556	0.560	0.557	0.550	0.558	0.550
269.0	0.573	0.563	0.559	0.557	0.576	0.564	0.555	0.562	0.555	0.563	0.500
283.3	0.495	0.491	0.478	0.498	0.496	0.511	0.480	0.497	0.478	0.495	0.450
299.1	1.014	1.005	1.039	1.021	1.012	1.036	1.029	1.019	1.005	1.020	0.676
322.0	0.409	0.415	0.406	0.412	0.404	0.413	0.402	0.419	0.402	0.411	0.380
339.0	0.404	0.407	0.405	0.405	0.401	0.406	0.402	0.405	0.401	0.405	0.380
358.0	0.419	0.405	0.409	0.402	0.409	0.407	0.451	0.411	0.402	0.409	0.380
367.0	0.466	0.486	0.469	0.470	0.480	0.478	0.484	0.497	0.466	0.479	0.380
377.5	0.673	0.739	0.826	0.777	0.806	0.787	0.768	0.777	0.673	0.777	0.530

Table 6
RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

PART NO. 1U76957-03
SERIAL NO. 0000007

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
	DEGREE LOCATIONS									
85.0	1.136	1.179	1.169	1.207	1.129	1.195	1.130	1.149	1.129	1.159
90.0	1.021	1.020	1.033	1.091	1.018	1.017	0.993	0.999	0.993	1.019
98.0	0.926	0.939	1.021	0.975	0.940	0.947	0.941	0.933	0.926	0.941
105.8	0.664	0.668	0.701	0.786	0.646	0.653	0.634	0.623	0.623	0.659
116.0	0.683	0.670	0.690	0.654	0.670	0.675	0.653	0.644	0.644	0.670
124.5	0.664	0.761	0.635	0.621	0.609	0.610	0.608	0.592	0.592	0.616
133.0	0.696	0.846	0.700	0.673	0.672	0.679	0.701	0.697	0.672	0.697
145.5	0.480	0.501	0.512	0.492	0.497	0.534	0.491	0.510	0.480	0.499
158.5	0.525	0.477	0.528	0.494	0.502	0.483	0.508	0.490	0.477	0.498
166.0	0.676	0.666	0.644	0.623	0.624	0.646	0.641	0.658	0.623	0.645
177.7	1.081	1.095	1.106	1.237	1.085	1.052	1.110	1.116	1.052	1.100
192.5	0.587	0.587	0.595	0.544	0.595	0.609	0.620	0.620	0.544	0.595
202.5	0.442	0.422	0.434	0.420	0.444	0.449	0.450	0.439	0.420	0.441
214.0	0.415	0.418	0.412	0.379	0.406	0.456	0.400	0.396	0.379	0.409
227.3	0.445	0.486	0.497	0.591	0.468	0.514	0.526	0.466	0.445	0.492
238.3	0.383	0.380	0.388	0.383	0.384	0.410	0.400	0.428	0.380	0.386
250.0	0.317	0.320	0.315	0.302	0.292	0.346	0.333	0.344	0.292	0.319
269.0	0.361	0.377	0.397	0.358	0.406	0.379	0.367	0.384	0.358	0.378
283.9	0.307	0.309	0.335	0.308	0.329	0.322	0.307	0.313	0.307	0.311
299.1	0.913	0.851	0.831	0.866	0.835	0.857	0.860	0.847	0.831	0.854
322.0	0.305	0.283	0.286	0.296	0.307	0.308	0.288	0.320	0.283	0.301
339.0	0.312	0.362	0.294	0.303	0.289	0.309	0.296	0.298	0.289	0.301
358.0	0.598	0.340	0.348	0.337	0.355	0.368	0.453	0.372	0.337	0.361
367.0	0.600	0.364	0.352	0.361	0.355	0.393	0.390	0.371	0.352	0.368
377.5	0.739	0.595	0.590	0.576	0.646	0.646	0.708	0.594	0.576	0.621

Table 6
RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS AVE.	EXPOSURE TIME
85.0	8.1	7.1	7.4	8.2	9.0	7.2	8.3	8.2	7.9	45.8
90.0	9.1	9.1	9.3	6.9	9.7	8.7	8.8	9.4	8.9	45.2
98.0	10.3	9.7	9.3	10.2	10.0	10.2	10.3	10.4	10.1	44.2
105.8	9.5	11.4	9.0	7.6	10.3	10.0	10.0	10.5	9.8	43.4
116.0	9.2	10.6	8.8	9.6	10.4	9.9	10.4	10.3	9.9	42.6
124.5	8.8	7.5	9.5	10.2	10.0	10.0	11.1	10.6	9.7	41.6
133.0	9.7	7.8	9.9	9.9	10.0	10.3	10.3	9.5	9.7	40.3
145.5	11.7	11.0	10.5	11.1	11.1	10.2	11.1	10.7	10.9	38.3
158.5	10.1	11.1	9.5	10.6	10.3	11.6	10.7	10.8	10.6	36.7
166.0	8.9	10.0	9.0	9.8	10.0	10.2	8.8	9.1	9.5	36.3
177.7	13.2	12.3	12.5	6.4	11.4	11.7	11.5	9.4	11.0	34.9
192.5	10.3	11.6	8.4	10.8	9.7	9.5	9.4	9.4	9.9	31.6
202.5	10.3	10.6	9.3	10.0	9.4	9.6	9.4	9.5	9.8	30.2
214.0	10.6	10.4	9.8	11.0	10.4	9.0	10.3	10.9	10.3	28.4
227.3	11.0	10.4	10.8	6.2	11.6	10.1	10.9	10.8	10.2	26.4
238.3	10.9	10.6	9.8	10.0	10.2	9.0	9.5	8.4	9.8	24.7
250.0	10.9	10.3	10.2	11.1	11.3	9.1	9.8	9.2	10.2	23.1
269.0	10.5	9.3	8.1	9.9	8.5	9.2	9.4	8.9	9.2	20.1
283.9	10.9	10.6	8.3	11.0	9.7	11.0	10.1	10.7	10.3	17.2
299.1	5.7	8.7	11.7	8.7	9.9	10.1	9.5	9.7	9.2	17.8
322.0	8.0	10.2	9.2	8.9	7.5	8.1	8.8	7.6	8.5	13.0
339.0	7.4	3.6	9.0	8.2	9.0	7.8	8.5	8.6	7.8	12.4
358.0	0	5.6	5.3	5.6	4.7	3.4	0	3.4	3.5	11.6
367.0	0	10.9	10.4	9.7	11.2	7.6	8.4	11.3	8.7	11.2
377.5	0	7.0	11.4	9.7	7.7	6.8	2.9	8.8	6.8	20.7

MOTOR ACTION TIME = 124.9 SECONDS

Table 6

RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MEDIAN	MAX.	DESIGN M+3S
	DEGREE LOCATIONS										
85.0	0.370	0.323	0.341	0.377	0.412	0.330	0.379	0.375	0.373	0.412	0.618
90.0	0.410	0.412	0.420	0.312	0.438	0.392	0.399	0.423	0.411	0.438	0.576
98.0	0.456	0.429	0.411	0.449	0.444	0.451	0.457	0.461	0.450	0.461	0.582
105.8	0.413	0.494	0.389	0.331	0.446	0.435	0.436	0.455	0.436	0.494	0.559
116.0	0.391	0.452	0.375	0.407	0.441	0.422	0.441	0.440	0.431	0.452	0.527
124.5	0.365	0.311	0.394	0.425	0.418	0.417	0.460	0.439	0.417	0.460	0.522
133.0	0.392	0.315	0.397	0.397	0.404	0.415	0.417	0.381	0.397	0.417	0.516
145.5	0.450	0.423	0.401	0.426	0.426	0.390	0.427	0.410	0.425	0.450	0.493
158.5	0.371	0.414	0.350	0.388	0.377	0.427	0.392	0.397	0.390	0.427	0.491
166.0	0.324	0.363	0.326	0.354	0.364	0.371	0.319	0.330	0.342	0.371	0.466
177.7	0.459<	0.431	0.435	0.224	0.399	0.409	0.400	0.328	0.404	0.459	0.452
192.5	0.324	0.365	0.264	0.341	0.305	0.301	0.298	0.296	0.303	0.365	0.400
202.5	0.310	0.320	0.280	0.303	0.285	0.291	0.283	0.288	0.289	0.320	0.376
214.0	0.300	0.294	0.278	0.311	0.296	0.257	0.293	0.310	0.295	0.311	0.351
227.3	0.291	0.274	0.284	0.164	0.307	0.266	0.288	0.285	0.285	0.307	0.317
238.3	0.268	0.263	0.242	0.247	0.252	0.222	0.235	0.208	0.244	0.268	0.331
250.0	0.251	0.239	0.235	0.256	0.261	0.210	0.227	0.213	0.237	0.261	0.285
269.0	0.212	0.186	0.162	0.199	0.170	0.185	0.188	0.178	0.186	0.212	0.297
283.9	0.188	0.182	0.143	0.190	0.167	0.189	0.173	0.184	0.183	0.190	0.251
299.1	0.101	0.151	0.208	0.155	0.177	0.179	0.169	0.172	0.171	0.208	0.253
322.0	0.104	0.132	0.120	0.116	0.097	0.105	0.114	0.099	0.110	0.132	0.197
339.0	0.092	0.045	0.111	0.102	0.112	0.097	0.106	0.107	0.104	0.112	0.190
358.0	0	0.065	0.061	0.065	0.054	0.039	0	0.039	0.047	0.065	0.181
367.0	0	0.122	0.117	0.109	0.125	0.085	0.094	0.126	0.113	0.126	0.175
377.5	0	0.144	0.236	0.201	0.160	0.141	0.060	0.183	0.152	0.236	0.237

A ' < ' INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

Table 6

RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
85.0	3.51	4.02	3.81	3.45	3.16	3.94	3.43	3.47	3.16	180.0	1.5
90.0	3.09	3.07	3.01	4.05	2.89	3.23	3.17	2.99	2.89	180.0	1.5
98.0	2.49	2.65	2.76	2.53	2.56	2.52	2.48	2.46	2.46	316.8	1.5
105.8	2.62	2.19	2.78	3.26	2.42	2.48	2.48	2.37	2.19	46.8	1.5
116.0	2.69	2.32	2.80	2.58	2.38	2.49	2.38	2.39	2.32	46.8	1.5
124.5	2.82	3.31	2.61	2.42	2.46	2.47	2.24	2.35	2.24	270.0	1.5
133.0	2.50	3.11	2.47	2.47	2.43	2.36	2.35	2.57	2.35	270.0	1.5
145.5	2.07	2.20	2.32	2.18	2.18	2.38	2.18	2.27	2.07	0.0	1.5
158.5	2.37	2.13	2.51	2.27	2.33	2.06	2.24	2.22	2.06	226.8	1.5
166.0	2.62	2.34	2.61	2.40	2.34	2.29	2.66	2.58	2.29	226.8	1.5
177.7	2.18	2.32	2.30	4.46	2.51	2.44	2.50	3.05	2.18	0.0	2.0
192.5	2.41	2.14	2.95	2.29	2.56	2.59	2.62	2.64	2.14	46.8	1.5
202.5	2.35	2.28	2.61	2.41	2.56	2.51	2.58	2.53	2.28	46.8	1.5
214.0	2.33	2.38	2.52	2.25	2.36	2.72	2.39	2.26	2.25	136.8	1.5
227.3	2.23	2.37	2.29	3.96	2.12	2.44	2.26	2.28	2.12	180.0	1.5
238.3	2.35	2.40	2.60	2.55	2.50	2.84	2.68	3.03	2.35	0.0	1.5
250.0	2.19	2.30	2.34	2.15	2.11	2.62	2.42	2.58	2.11	180.0	1.5
269.0	2.36	2.69	3.09	2.51	2.94	2.70	2.66	2.81	2.36	0.0	1.5
283.9	2.39	2.47	3.15	2.37	2.69	2.38	2.60	2.45	2.37	136.8	1.5
299.1	6.69	4.39	3.25	4.36	3.82	3.78	4.00	3.93	3.25	90.0	2.0
322.0	3.65	2.88	3.17	3.28	3.92	3.62	3.33	3.84	2.88	46.8	1.5
339.0	4.13	8.44	3.42	3.73	3.39	3.92	3.58	3.55	3.39	180.0	1.5
358.0	+	5.85	6.23	5.85	7.04	9.74	+	9.74	5.85	46.8	1.5
367.0	+	3.11	3.25	3.49	3.04	4.47	4.04	3.02	3.02	316.8	1.5
377.5	+	3.68	2.25	2.64	3.31	3.76	8.83	2.90	2.25	90.0	1.5

SEGMENT MINIMUM = 2.06 AT THE 158.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 6

RSRM-21A AFT CYLINDER INSULATION PERFORMANCE

ACTUAL SAFETY FACTOR (ASF)

STATION								DEGREE	LOCATIONS		REQUIRED
(IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	PLANE	S.F.
85.0	4.07	4.65	4.43	4.20	3.74	4.62	3.98	4.06	3.74	180.0	1.5
90.0	3.49	3.48	3.46	4.50	3.32	3.59	3.49	3.36	3.32	180.0	1.5
98.0	3.03	3.19	3.48	3.17	3.12	3.10	3.06	3.02	3.02	316.8	1.5
105.8	2.61	2.35	2.80	3.37	2.45	2.50	2.45	2.37	2.35	46.8	1.5
116.0	2.75	2.48	2.84	2.61	2.52	2.60	2.48	2.46	2.46	316.8	1.5
124.5	2.82	3.45	2.61	2.46	2.46	2.46	2.32	2.35	2.32	270.0	1.5
133.0	2.78	3.69	2.76	2.70	2.66	2.64	2.68	2.83	2.64	226.8	1.5
145.5	2.07	2.18	2.28	2.15	2.17	2.37	2.15	2.24	2.07	0.0	1.5
158.5	2.42	2.15	2.51	2.27	2.33	2.13	2.30	2.23	2.13	226.8	1.5
166.0	3.09	2.83	2.98	2.76	2.71	2.74	3.01	2.99	2.71	180.0	1.5
177.7	3.36	3.54	3.54	6.52	3.72	3.57	3.78	4.40	3.36	0.0	2.0
192.5	2.81	2.61	3.25	2.60	2.95	3.02	3.08	3.09	2.60	136.8	1.5
202.5	2.43	2.32	2.55	2.39	2.56	2.54	2.59	2.52	2.32	46.8	1.5
214.0	2.38	2.42	2.48	2.22	2.37	2.77	2.37	2.28	2.22	136.8	1.5
227.3	2.53	2.77	2.75	4.60	2.52	2.93	2.83	2.64	2.52	180.0	1.5
238.3	2.43	2.44	2.60	2.55	2.52	2.85	2.70	3.06	2.43	0.0	1.5
250.0	2.26	2.34	2.34	2.18	2.12	2.65	2.47	2.62	2.12	180.0	1.5
269.0	2.70	3.03	3.45	2.80	3.39	3.05	2.95	3.16	2.70	0.0	1.5
281.9	2.63	2.70	3.34	2.62	2.97	2.70	2.77	2.70	2.62	136.8	1.5
299.1	10.04	6.53	5.00	6.59	5.72	5.79	6.09	5.92	5.00	90.0	2.0
322.0	3.93	3.14	3.38	3.55	4.16	3.93	3.53	4.23	3.14	46.8	1.5
339.0	4.39	9.04	3.65	3.97	3.58	4.19	3.79	3.79	3.58	180.0	1.5
358.0	+	6.23	6.70	6.18	7.57	10.44	+	10.54	6.18	136.8	1.5
367.0	+	3.98	4.01	4.31	3.84	5.62	5.15	3.94	3.84	180.0	1.5
377.5	+	5.13	3.50	3.87	5.04	5.58	12.80	4.25	3.50	90.0	1.5

SEGMENT MINIMUM = 2.07 AT THE 145.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 7
RSRM-21A AFT CENTER SEGMENT IN..LATION PERFORMANCE

PART NO. 1U76667-02
SERIAL NO. 0000029

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
3.5	2.453	2.493	2.524	2.574	2.463	2.476	2.502	2.533	2.453	2.498	2.120
11.0	2.205	2.231	2.186	2.388	2.250	2.524	2.427	2.415	2.186	2.319	1.900
30.7	0.808	0.831	0.834	0.876	0.864	0.863	0.897	0.848	0.808	0.855	0.774
36.2	0.769	0.793	0.815	0.815	0.818	0.826	0.807	0.799	0.769	0.811	0.600
44.6	0.373	0.372	0.379	0.366	0.371	0.362	0.365	0.366	0.362	0.368	0.360
71.5	0.192	0.182	0.185	0.187	0.190	0.190	0.190	0.185	0.182	0.189	0.170
126.0	0.157	0.160	0.154	0.156	0.157	0.160	0.155	0.154	0.154	0.157	0.150
145.0	0.155	0.142	0.150	0.140	0.156	0.161	0.150	0.154	0.140	0.152	0.150
161.4	0.523	0.555	0.566	0.573	0.622	0.592	0.684	0.535	0.523	0.570	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.190	0.178	0.186	0.185	0.189	0.185	0.190	0.185	0.178	0.186	0.130
214.1	0.132	0.130	0.131	0.133	0.136	0.132	0.136	0.135	0.130	0.133	0.130
280.0	0.106	0.096	0.099	0.102	0.107	0.102	0.106	0.100	0.096	0.102	0.090
298.0	0.103	0.095	0.098	0.102	0.100	0.102	0.100	0.100	0.095	0.100	0.090
311.8	0.106	0.102	0.101	0.112	0.107	0.107	0.107	0.104	0.101	0.106	0.090

PART NO. 1U76791-01
SERIAL NO. 0000013

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
3.5	2.212	2.192	2.204	2.135	2.149	2.126	2.234	2.266	2.126	2.198
11.0	2.009	2.098	1.898	2.020	2.216	1.988	2.259	2.097	1.898	2.059
30.7	0.542	0.535	0.626	0.535	0.573	0.548	0.565	0.543	0.535	0.545
36.2	0.607	0.569	0.614	0.605	0.588	0.620	0.616	0.566	0.566	0.606
44.6	0.312	0.280	0.306	0.290	0.309	0.299	0.287	0.295	0.280	0.297
71.5	0.151	0.136	0.140	0.117	0.116	0.127	0.121	0.122	0.116	0.125
126.0	0.148	0.185	0.136	0.155	0.118	0.123	0.123	0.123	0.118	0.130
145.0	0.125	0.125	0.137	0.129	0.138	0.112	0.111	0.108	0.108	0.125
161.4	0.525	0.477	0.502	0.593	0.495	0.475	0.491	0.516	0.475	0.498
163.0	0.467	0.470	0.447	0.562	0.469	0.460	0.440	0.455	0.440	0.464
178.0	0.176	0.153	0.165	0.149	0.146	0.149	0.132	0.166	0.132	0.151
214.1	0.132	L	L	0.119	0.097	0.119	0.127	0.136	0.097	0.128
280.0	L	L	L	L	L	L	L	L	L	0.102
298.0	L	L	L	L	L	L	L	L	L	0.100
311.8	L	L	L	L	L	L	L	L	L	0.106

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 7

RSRM-21A AFT CENTER SEGMENT INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.241	0.301	0.320	0.439	0.314	0.350	0.268	0.267	0.308	0.439	1.067
11.0	0.196	0.133	0.288	0.368	0.034	0.536	0.168	0.318	0.242	0.536	0.829
30.7	0.266	0.296	0.208	0.341	0.291	0.315	0.332	0.305	0.300	0.341	0.484
36.2	0.162	0.224	0.201	0.210	0.230	0.206	0.191	0.233	0.208	0.233	0.318
44.6	0.061	0.092<	0.073	0.076	0.062	0.063	0.078	0.071	0.072	0.092	0.090
71.5	0.041	0.046	0.045	0.070	0.074	0.063	0.069	0.063	0.063	0.074	0.086
126.0	0.009	[illegible]	0.018	0.001	0.039	0.037	0.032	0.031	0.024	0.039	0.074
145.0	0.030	0.017	0.013	0.011	0.018	0.049	0.039	0.046	0.024	0.049	0.063
161.4	0	0.078	0.064	0	0.127<	0.117<	0.193<	0.019	0.071	0.193	0.082
163.0	0.083<	0.080	0.103<	0	0.081	0.090<	0.110<	0.095<	0.087	0.110	0.082
178.0	0.014	0.025	0.021	0.036	0.043	0.036	0.058	0.019	0.031	0.058	0.065
214.1	0	0	0	0.014	0.039<	0.013	0.009	0	0.005	0.039	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	2.1	2.7	2.8	3.9	2.8	3.1	2.4	2.4	2.8	113.5
11.0	2.0	1.3	2.9	3.7	0.3	5.4	1.7	3.2	2.6	98.7
30.7	5.5	6.1	4.3	7.1	6.0	6.5	6.9	6.3	6.1	48.3
36.2	4.9	6.8	6.1	6.4	7.0	6.2	5.8	7.1	6.3	33.0
44.6	5.0	7.5	6.0	6.2	5.1	5.2	6.4	5.8	5.9	12.2
71.5	4.0	4.5	4.4	6.8	7.2	6.1	6.7	6.1	5.7	10.3
126.0	1.0	0	2.0	0.1	4.4	4.2	3.6	3.5	2.3	8.9
145.0	4.0	2.3	1.7	1.5	2.4	6.5	5.2	6.1	3.7	7.5
161.4	0	7.7	6.3	0	12.6	11.6	19.1	1.9	7.4	10.1
163.0	8.2	7.9	10.2	0	8.0	8.9	10.9	9.4	7.9	10.1
178.0	2.3	4.1	3.4	5.9	7.0	5.9	9.5	3.1	5.2	6.1
214.1	0	0	0	2.3	6.4	2.1	1.5	0	1.5	6.1
280.0	0	0	0	0	0	0	0	0	0	3.4
298.0	0	0	0	0	0	0	0	0	0	2.8
311.8	0	0	0	0	0	0	0	0	0	2.0

MOTOR ACTION TIME = 124.9 SECONDS

Table 7
RSRM-21A AFT CENTER SEGMENT INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	8.80	7.04	6.63	4.83	6.75	6.06	7.91	7.94	4.83	136.0	2.0
11.0	9.69	14.29	6.60	5.16	55.88	3.54	11.31	5.97	3.54	226.0	1.5
30.7	2.91	2.61	3.72	2.27	2.66	2.46	2.33	2.54	2.27	136.0	1.5
36.2	3.70	2.68	2.99	2.86	2.61	2.91	3.14	2.58	2.58	316.0	1.5
44.6	5.90	3.91	4.93	4.74	5.81	5.71	4.62	5.07	3.91	46.0	1.5
71.5	4.15	3.70	3.78	2.43	2.30	2.70	2.46	2.70	2.30	180.0	1.5
126.0	16.67	+	8.33	+	3.85	4.05	4.69	4.84	3.85	180.0	1.5
145.0	5.00	8.82	11.54	13.64	8.33	3.06	3.85	3.26	3.06	226.0	1.5
161.4	+	3.03	3.69	+	1.86<	2.02	1.22<	12.42	1.22	270.0	2.0
163.0	2.84	2.95	2.29	+	2.91	3.62	2.15	2.48	2.15	270.0	1.5
170.0	9.29	5.20	6.19	3.61	3.02	3.61	2.24	6.84	2.24	270.0	1.5
214.1	+	+	+	9.29	3.33	10.00	14.44	+	3.33	180.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 1.22 AT THE 161.4 INCH STATION
A " < " INDICATES THE PRECEDING SAFETY FACTOR HAS VIOLATED THE MINIMUM SAFETY FACTOR REQUIREMENT
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	10.18	8.28	7.89	5.86	7.84	7.07	9.34	9.49	5.86	136.0	2.0
11.0	11.25	16.77	7.59	6.49	66.18	4.71	14.45	7.59	4.71	226.0	1.5
30.7	3.04	2.81	4.01	2.57	2.97	2.74	2.70	2.78	2.57	136.0	1.5
36.2	4.75	3.54	4.05	3.88	3.56	4.01	4.23	3.43	3.43	316.0	1.5
44.6	6.11	4.04	5.19	4.82	5.98	5.75	4.68	5.15	4.04	46.0	1.5
71.5	4.68	3.96	4.11	2.67	2.57	3.02	2.75	2.94	2.57	180.0	1.5
126.0	17.44	+	8.56	+	4.03	4.32	4.34	4.97	4.03	180.0	1.5
145.0	5.17	8.35	11.54	12.73	8.67	3.29	3.85	3.35	3.29	226.0	1.5
161.4	+	7.12	8.84	+	4.90	5.06	3.54	28.16	3.54	270.0	2.0
163.0	6.63	6.87	5.34	+	6.79	6.11	5.00	5.79	5.00	270.0	1.5
170.0	13.57	7.12	8.86	5.14	4.40	5.14	3.28	9.74	3.28	270.0	1.5
214.1	+	+	+	9.53	3.49	10.15	15.11	+	3.49	180.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 2.57 AT THE 71.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 8
RSRM-21A FORWARD CENTER SEGMENT INSULATION PERFORMANCE

PART NO. 1U76667-02 PREFIRE MEASUREMENTS
SERIAL NO. 0000030 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
3.5	2.771	2.735	2.654	2.703	2.703	2.561	2.541	2.639	2.541	2.679	2.120
11.0	2.413	2.561	2.531	2.383	2.585	2.512	2.446	2.498	2.383	2.505	1.900
30.7	0.859	0.871	0.873	0.926	0.872	0.868	0.857	0.918	0.857	0.872	0.774
36.2	0.815	0.847	0.834	0.859	0.823	0.790	0.815	0.800	0.790	0.819	0.600
44.6	0.366	0.365	0.364	0.370	0.367	0.375	0.380	0.374	0.364	0.369	0.360
71.5	0.208	0.187	0.185	0.185	0.184	0.186	0.187	0.185	0.184	0.186	0.170
126.0	0.163	0.152	0.156	0.152	0.158	0.159	0.157	0.156	0.152	0.157	0.150
145.0	0.157	0.159	0.155	0.158	0.157	0.155	0.151	0.160	0.151	0.157	0.150
161.4	0.592	0.570	0.540	0.577	0.551	0.549	0.619	0.550	0.540	0.561	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.194	0.192	0.184	0.189	0.185	0.188	0.187	0.185	0.184	0.188	0.130
214.1	0.136	0.131	0.131	0.130	0.131	0.131	0.130	0.131	0.130	0.131	0.130
280.0	0.106	0.106	0.101	0.116	0.102	0.107	0.104	0.103	0.101	0.105	0.090
298.0	0.103	0.108	0.103	0.117	0.102	0.097	0.103	0.105	0.097	0.103	0.090
311.8	0.097	0.097	0.098	0.101	0.103	0.095	0.099	0.097	0.095	0.098	0.090

PART NO. 1U76791-01 POSTFIRE MEASUREMENTS
SERIAL NO. 0000015 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
3.5	2.455	2.459	2.493	2.477	2.400	2.467	2.473	2.529	2.400	2.470
11.0	2.325	2.270	2.340	2.282	2.369	2.274	2.249	2.291	2.249	2.286
30.7	0.729	0.744	0.759	0.761	0.721	0.732	0.723	0.742	0.721	0.737
36.2	0.733	0.715	0.726	0.750	0.715	0.703	0.697	0.735	0.697	0.720
44.6	0.333	0.339	0.338	0.334	0.335	0.345	0.321	0.342	0.321	0.337
71.5	0.201	0.162	0.166	0.148	0.168	0.163	0.145	0.146	0.145	0.163
126.0	0.145	0.138	0.146	0.141	0.149	0.143	0.137	0.119	0.119	0.142
145.0	0.141	0.155	0.184	0.154	0.133	0.138	0.125	0.129	0.125	0.140
161.4	0.559	0.525	0.514	0.525	0.515	0.528	0.551	0.527	0.514	0.526
163.0	0.515	0.481	0.491	0.476	0.491	0.490	0.469	0.469	0.469	0.486
178.0	0.170	0.177	L	0.208	0.176	0.174	0.161	0.170	0.161	0.175
214.1	0.130	L	L	L	L	L	0.110	0.130	0.110	0.131
280.0	L	L	L	L	L	L	L	L	L	0.105
298.0	L	L	L	L	L	L	L	L	L	0.103
311.8	L	L	L	L	L	L	L	L	L	0.098

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 8
RSRM-21A FORWARD CENTER SEGMENT INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.316	0.276	0.161	0.226	0.303	0.094	0.068	0.110	0.194	0.316	1.067
11.0	0.088	0.291	0.191	0.101	0.216	0.238	0.197	0.207	0.202	0.291	0.829
30.7	0.130	0.127	0.114	0.165	0.151	0.136	0.134	0.176	0.135	0.176	0.484
36.2	0.082	0.132	0.108	0.109	0.108	0.087	0.118	0.065	0.108	0.132	0.318
44.6	0.033	0.026	0.026	0.036	0.032	0.030	0.059	0.032	0.032	0.059	0.090
71.5	0.007	0.025	0.019	0.037	0.016	0.023	0.042	0.039	0.024	0.042	0.086
126.0	0.018	0.014	0.010	0.011	0.009	0.016	0.020	0.037	0.015	0.037	0.074
145.0	0.016	0.004	0	0.004	0.024	0.017	0.026	0.031	0.017	0.031	0.063
161.4	0.033	0.045	0.026	0.052	0.036	0.021	0.068	0.023	0.035	0.068	0.082
163.0	0.035	0.069	0.059	0.074	0.059	0.060	0.081	0.081	0.065	0.081	0.082
178.0	0.024	0.015	0	0	0.009	0.014	0.026	0.015	0.014	0.026	0.065
214.1	0.006	0	0	0	0	0	0.020	0.001	0	0.020	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	2.8	2.4	1.4	2.0	2.7	0.8	0.6	1.0	1.7	113.5
11.0	0.9	2.9	1.9	1.0	2.2	2.4	2.0	2.1	1.9	98.9
30.7	2.7	2.6	2.3	3.4	3.1	2.8	2.8	3.6	2.9	48.7
36.2	2.4	3.9	3.2	3.2	3.2	2.6	3.5	1.9	3.0	33.7
44.6	2.5	2.0	2.0	2.8	2.5	2.3	4.5	2.5	2.6	13.0
71.5	0.6	2.2	1.7	3.3	1.4	2.1	3.8	3.5	2.3	11.2
126.0	1.9	1.4	1.0	1.1	0.9	1.6	2.1	3.8	1.7	9.7
145.0	2.0	0.5	0	0.5	3.0	2.1	3.2	3.8	1.9	8.1
161.4	3.0	4.1	2.4	4.8	3.3	1.9	6.2	2.1	3.5	10.9
163.0	3.2	6.3	5.4	6.8	5.4	5.5	7.4	7.4	5.9	10.9
178.0	3.3	2.1	0	0	1.2	1.9	3.6	2.1	1.8	7.3
214.1	0.8	0	0	0	0	0	2.7	0.1	0.5	7.3
280.0	0	0	0	0	0	0	0	0	0	4.3
298.0	0	0	0	0	0	0	0	0	0	4.1
311.8	0	0	0	0	0	0	0	0	0	3.4

MOTOR ACTION TIME = 124.9 SECONDS

REVISION ___

Table 8
RSRM-21A FORWARD CENTER SEGMENT INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	6.71	7.68	13.17	9.38	7.00	22.55	31.18	19.27	6.71	0.0	2.0
11.0	21.59	6.53	9.95	14.81	8.80	7.98	9.64	9.18	6.53	46.0	1.5
30.7	5.95	6.09	6.79	4.69	5.13	5.69	5.78	4.40	4.40	316.0	1.5
36.2	7.32	4.55	5.56	5.58	5.56	6.90	5.08	9.23	4.55	46.0	1.5
44.6	10.91	13.85	13.85	10.00	11.25	12.00	6.10	11.25	6.10	270.0	1.5
71.5	24.29	6.80	8.95	4.59	10.62	7.39	4.05	4.36	4.05	270.0	1.5
126.0	8.33	10.71	15.00	13.64	16.67	9.38	7.50	4.05	4.05	316.0	1.5
145.0	9.37	37.50	+	37.50	6.25	8.82	5.77	4.84	4.84	316.0	1.5
161.4	7.15	5.24	9.08	4.54	6.56	11.24	3.47	10.26	3.47	270.0	2.0
163.0	6.74	3.42	4.00	3.13	4.00	3.93	2.91	2.91	2.91	270.0	1.5
178.0	5.42	8.67	+	+	14.44	9.29	5.00	8.67	5.00	270.0	1.5
214.1	21.67	+	+	+	+	+	6.50	+	6.50	270.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 2.91 AT THE 163.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	8.77	9.91	16.48	11.96	8.92	27.24	37.37	23.99	8.77	0.0	2.0
11.0	27.42	8.80	13.25	23.59	11.97	10.55	12.42	12.07	8.80	46.0	1.5
30.7	6.61	6.86	7.66	5.61	5.77	6.38	6.40	5.22	5.22	316.0	1.5
36.2	9.94	6.42	7.72	7.88	7.62	9.08	6.91	12.31	6.42	46.0	1.5
44.6	11.09	14.04	14.00	10.28	11.47	12.50	6.44	11.69	6.44	270.0	1.5
71.5	29.71	7.48	9.74	5.00	11.50	8.09	4.45	4.74	4.45	270.0	1.5
126.0	9.06	10.86	15.60	13.82	17.56	9.94	7.85	4.22	4.22	316.0	1.5
145.0	9.81	39.75	+	39.50	6.54	9.12	5.81	5.16	5.16	316.0	1.5
161.4	17.94	12.67	20.77	11.10	15.31	26.14	9.10	23.91	9.10	270.0	2.0
163.0	15.71	7.97	9.32	7.43	9.32	9.17	6.79	6.79	6.79	270.0	1.5
178.0	8.08	12.80	+	+	20.56	13.43	7.19	12.33	7.19	270.0	1.5
214.1	22.67	+	+	+	+	+	6.50	+	6.50	270.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 4.22 AT THE 126.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 9
RSRM-21A FORWARD SEGMENT ..AR TIP INSULATION PERFORMANCE

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76666-02
SERIAL NO. 0000016

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN	MDT
3.5	2.524	2.541	2.519	2.534	2.580	2.519	2.534	2.120
13.0	1.002	0.921	0.969	0.929	0.926	0.921	0.929	0.650
27.0	0.601	0.612	0.600	0.702	0.597	0.597	0.601	0.480
44.0	0.305	0.301	0.296	0.298	0.298	0.296	0.298	0.250
60.0	0.137	0.141	0.140	0.149	0.151	0.137	0.141	0.100
94.7	0.107	0.110	0.113	0.094	0.117	0.094	0.110	0.090
142.0	0.164	0.162	0.165	0.171	0.166	0.162	0.165	0.113
152.0	0.380	0.386	0.395	0.403	0.382	0.380	0.386	0.317
162.0	0.751	0.780	0.793	0.811	0.749	0.749	0.780	0.547
175.5	0.716	0.570	0.694	0.665	0.726	0.570	0.694	0.604
187.0	0.671	0.633	0.641	0.666	0.669	0.633	0.666	0.640
199.0	0.743	0.728	0.737	0.743	0.747	0.728	0.743	0.683
213.0	0.752	0.728	0.728	0.725	0.749	0.725	0.728	0.677
224.0	0.796	0.785	0.799	0.769	0.804	0.769	0.796	0.677
230.0	0.731	0.718	0.819	0.761	0.735	0.718	0.735	0.677
236.0	0.660	0.650	0.680	0.682	0.664	0.650	0.664	0.578
240.0	0.676	0.642	0.666	0.669	0.660	0.642	0.666	0.574
254.0	0.719	0.673	0.674	0.691	0.658	0.658	0.674	0.568
263.0	0.603	0.582	0.611	0.604	0.599	0.582	0.603	0.568
282.0	0.658	0.641	0.672	0.661	0.654	0.641	0.658	0.568
293.0	0.644	0.600	0.647	0.630	0.620	0.600	0.630	0.546
305.0	0.675	0.654	0.690	0.673	0.695	0.654	0.675	0.525
312.0	0.654	0.654	0.659	0.649	0.633	0.633	0.654	0.541
321.0	1.030	1.048	1.084	1.094	1.037	1.030	1.048	0.918
339.0	0.593	0.587	0.619	0.592	0.589	0.587	0.592	0.551
350.0	0.599	0.612	0.592	0.640	0.620	0.592	0.612	0.523
362.0	0.596	0.617	0.610	0.592	0.592	0.592	0.596	0.520
371.0	0.623	0.588	0.616	0.640	0.655	0.588	0.623	0.520
383.0	0.584	0.618	0.586	0.583	0.605	0.583	0.586	0.511
397.0	0.595	0.580	0.632	0.640	0.598	0.580	0.598	0.503
403.0	1.100	1.118	1.136	1.150	1.084	1.084	1.118	0.950

POSTFIRE MEASUREMENTS
INCHES

PART NO. 1U76790-05
SERIAL NO. 0000005

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN
3.5	2.431	2.354	2.446	2.480	2.523	2.354	2.446
13.0	0.914	0.822	0.842	0.822	0.805	0.805	0.822
27.0	L	L	L	L	L	L	0.601
44.0	L	L	L	L	L	L	0.298
60.0	L	L	L	L	L	L	0.141
94.7	L	L	L	L	L	L	0.110
142.0	L	L	L	L	L	L	0.165
152.0	0.323	0.299	0.338	0.319	0.325	0.299	0.323
162.0	0.638	0.642	0.637	0.606	0.646	0.606	0.638
175.5	0.530	0.515	0.495	0.507	0.505	0.495	0.507
187.0	0.430	0.400	0.459	0.405	0.407	0.400	0.407
199.0	0.537	0.496	0.529	0.484	0.547	0.484	0.529
213.0	0.489	0.520	0.526	0.504	0.513	0.489	0.513
224.0	0.532	0.568	0.554	0.511	0.534	0.511	0.534
230.0	0.506	0.479	0.533	0.497	0.496	0.479	0.497
236.0	0.421	0.415	0.481	0.445	0.444	0.415	0.444
240.0	0.428	0.408	0.461	0.386	0.424	0.386	0.424
254.0	0.444	0.427	0.430	0.423	0.449	0.423	0.430
263.0	0.368	0.408	0.384	0.323	0.386	0.323	0.384
282.0	0.454	0.440	0.462	0.425	0.466	0.425	0.454
293.0	0.399	0.404	0.434	0.417	0.415	0.399	0.415
305.0	0.456	0.479	0.482	0.449	0.455	0.449	0.456
312.0	0.476	0.464	0.443	0.414	0.451	0.414	0.451
321.0	0.814	0.767	0.819	0.778	0.839	0.767	0.814
339.0	0.422	0.416	0.432	0.396	0.401	0.396	0.416
350.0	0.425	0.419	0.408	0.500	0.423	0.408	0.423
362.0	0.372	0.435	0.445	0.419	0.420	0.372	0.420
371.0	0.479	0.495	0.511	0.455	0.455	0.455	0.479
383.0	0.444	0.387	0.411	0.368	0.454	0.368	0.411
397.0	0.422	0.405	0.410	0.441	0.434	0.405	0.422
403.0	0.894	0.866	0.913	0.863	0.903	0.863	0.894

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 9

RSRM-21A FORWARD SEGMENT STAR TIP INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.093	0.187<	0.073	0.054	0.065	0.073	0.187	0.103
13.0	0.088	0.099	0.127<	0.107<	0.121<	0.107	0.127	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
60.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.057	0.087	0.057	0.084	0.057	0.057	0.087	0.123
162.0	0.113	0.138	0.156	0.205	0.103	0.138	0.205	0.227
175.5	0.178	0.055	0.199	0.158	0.221	0.178	0.221	0.324
187.0	0.241	0.233	0.182	0.261	0.262	0.241	0.262	0.398
199.0	0.206	0.232	0.208	0.259	0.200	0.208	0.259	0.427
213.0	0.263	0.208	0.202	0.221	0.236	0.221	0.263	0.423
224.0	0.264	0.217	0.245	0.258	0.270	0.258	0.270	0.422
230.0	0.225	0.239	0.286	0.264	0.239	0.239	0.286	0.375
236.0	0.239	0.235	0.199	0.237	0.220	0.235	0.239	0.327
240.0	0.248	0.234	0.205	0.283	0.236	0.236	0.283	0.342
254.0	0.275	0.246	0.244	0.268	0.209	0.246	0.275	0.318
263.0	0.235	0.174	0.227	0.281	0.213	0.227	0.281	0.334
282.0	0.204	0.201	0.210	0.236	0.188	0.204	0.236	0.349
293.0	0.245	0.186	0.213	0.213	0.205	0.213	0.245	0.330
305.0	0.219	0.175	0.208	0.224	0.240	0.219	0.240	0.309
312.0	0.170	0.190	0.216	0.235	0.182	0.190	0.235	0.308
321.0	0.216	0.281	0.265	0.316	0.198	0.265	0.316	0.434
339.0	0.171	0.171	0.187	0.196	0.188	0.187	0.196	0.319
350.0	0.174	0.193	0.184	0.140	0.197	0.184	0.197	0.300
362.0	0.224	0.182	0.165	0.173	0.172	0.173	0.224	0.285
371.0	0.144	0.093	0.105	0.185	0.200	0.144	0.200	0.304
383.0	0.140	0.231	0.175	0.215	0.151	0.175	0.231	0.295
397.0	0.173	0.175	0.222	0.199	0.164	0.175	0.222	0.287
403.0	0.214	0.282	0.223	0.287	0.181	0.223	0.287	0.287

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	AVE.	EXPOSURE TIME
3.5	2.7	5.4	2.1	1.5	1.9	2.7	34.9
13.0	4.5	5.0	6.4	5.4	6.1	5.5	19.7
27.0	0	0	0	0	0	0	4.9
44.0	0	0	0	0	0	0	3.0
60.0	0	0	0	0	0	0	1.4
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	1.7	2.6	1.7	2.5	1.7	2.1	33.0
162.0	1.9	2.3	2.7	3.5	1.8	2.4	58.8
175.5	2.0	0.6	2.2	1.7	2.4	1.8	90.4
187.0	2.3	2.3	1.8	2.5	2.5	2.3	103.4
199.0	2.0	2.2	2.8	2.5	1.9	2.1	103.4
213.0	2.5	2.0	2.0	2.1	2.3	2.2	103.4
224.0	2.6	2.1	2.4	2.5	2.6	2.4	103.4
230.0	2.2	2.3	2.8	2.6	2.3	2.4	103.4
236.0	2.3	2.3	1.9	2.3	2.1	2.2	103.4
240.0	2.4	2.3	2.0	2.7	2.3	2.3	103.4
254.0	2.7	2.4	2.4	2.6	2.0	2.4	103.4
263.0	2.3	1.7	2.2	2.7	2.1	2.2	103.4
282.0	2.0	1.9	2.0	2.3	1.8	2.0	103.4
293.0	2.4	1.9	2.1	2.1	2.0	2.1	103.4
305.0	2.1	1.7	2.0	2.2	2.3	2.1	103.4
312.0	1.7	1.8	2.1	2.3	1.8	1.9	103.4
321.0	2.0	2.7	2.5	3.0	1.9	2.4	105.6
339.0	1.7	1.7	1.8	1.9	1.8	1.8	102.0
350.0	1.7	1.9	1.8	1.4	1.9	1.7	101.8
362.0	2.2	1.8	1.6	1.7	1.7	1.8	100.8
371.0	1.5	1.0	1.1	1.9	2.1	1.5	96.3
383.0	1.4	2.4	1.8	2.2	1.5	1.9	97.5
397.0	1.7	1.7	2.2	2.0	1.6	1.8	101.8
403.0	1.7	2.0	1.8	2.3	1.4	1.9	124.9

MOTOR ACTION TIME = 124.9 SECONDS

Table 9
RSRM-21A FORWARD SEGMENT STAR TIP INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE	REQUIRED S.F.
3.5	22.80	11.34	29.04	39.26	32.62	11.34	154.0	2.0
13.0	7.39	6.57	5.12	6.07	5.37	5.12	222.0	1.5
27.0	+	+	+	+	+	+	90.0	1.5
44.0	+	+	+	+	+	+	90.0	1.5
60.0	+	+	+	+	+	+	90.0	1.5
94.7	+	+	+	+	+	+	90.0	1.5
142.0	+	+	+	+	+	+	90.0	1.5
152.0	5.56	3.64	5.56	3.77	5.56	3.64	154.0	1.5
162.0	4.84	3.96	3.51	2.67	5.31	2.67	286.0	2.0
175.5	3.39	10.98	3.04	3.82	2.73	2.73	352.0	1.5
187.0	2.66	2.75	3.52	2.45	2.44	2.44	352.0	1.5
199.0	3.32	2.94	3.28	2.64	3.42	2.64	286.0	1.5
213.0	2.57	3.25	3.35	3.06	2.87	2.57	90.0	1.5
224.0	2.56	3.12	2.76	2.62	2.51	2.51	352.0	1.5
230.0	3.01	2.83	2.37	2.56	2.83	2.37	222.0	1.5
236.0	2.42	2.46	2.98	2.44	2.63	2.42	90.0	1.5
240.0	2.31	2.45	2.88	2.03	2.43	2.03	286.0	1.5
254.0	2.07	2.31	2.33	2.12	2.72	2.07	90.0	1.5
263.0	2.42	3.26	2.80	2.02	2.67	2.02	286.0	1.5
282.0	2.78	2.83	2.70	2.41	3.02	2.41	286.0	1.5
293.0	2.23	2.79	2.56	2.56	2.66	2.23	90.0	1.5
305.0	2.40	3.08	2.52	2.34	2.19	2.19	352.0	1.5
312.0	3.04	2.85	2.50	2.30	2.97	2.30	286.0	1.5
321.0	4.25	3.27	3.46	2.91	4.64	2.91	286.0	2.0
339.0	3.22	3.22	2.95	2.81	2.93	2.81	286.0	1.5
350.0	3.01	2.71	2.84	3.74	2.65	2.65	352.0	1.5
362.0	2.32	2.86	3.15	3.01	3.02	2.32	90.0	1.5
371.0	3.61	5.59	4.95	2.81	2.60	2.60	352.0	1.5
383.0	3.65	2.21	2.92	2.38	3.38	2.21	154.0	1.5
397.0	2.91	2.87	2.27	2.53	3.07	2.27	222.0	1.5
403.0	4.44	3.77	4.26	3.31	5.25	3.31	286.0	1.5

SEGMENT MINIMUM = 2.02 AT THE 263.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE
3.5	27.14	13.59	34.51	46.93	39.82	13.59	154.0
13.0	11.39	9.30	7.63	8.68	7.65	7.63	222.0
27.0	+	+	+	+	+	+	90.0
44.0	+	+	+	+	+	+	90.0
60.0	+	+	+	+	+	+	90.0
94.7	+	+	+	+	+	+	90.0
142.0	+	+	+	+	+	+	90.0
152.0	6.67	4.44	6.93	4.80	6.70	4.44	154.0
162.0	6.65	5.65	5.08	3.96	7.27	3.96	286.0
175.5	4.02	10.36	3.49	4.21	3.29	3.29	352.0
187.0	2.78	2.72	3.52	2.55	2.55	2.55	286.0
199.0	3.61	3.14	3.54	2.87	3.74	2.87	286.0
213.0	2.86	3.50	3.60	3.28	3.17	2.86	90.0
224.0	3.02	3.62	3.26	2.98	2.98	2.98	352.0
230.0	3.25	3.00	2.86	2.88	3.08	2.86	222.0
236.0	2.76	2.77	3.42	2.88	3.02	2.76	90.0
240.0	2.73	2.74	3.25	2.36	2.80	2.36	286.0
254.0	2.61	2.74	2.76	2.58	3.15	2.58	286.0
263.0	2.57	3.34	2.69	2.15	2.81	2.15	286.0
282.0	3.23	3.19	3.20	2.80	3.48	2.80	286.0
293.0	2.63	3.06	3.04	2.96	3.02	2.63	90.0
305.0	3.08	3.74	3.32	3.00	2.90	2.90	352.0
312.0	3.67	3.44	3.05	2.76	3.48	2.76	286.0
321.0	4.77	3.73	4.09	3.46	5.24	3.46	286.0
339.0	3.47	3.43	3.31	3.02	3.13	3.02	286.0
350.0	3.44	3.17	3.22	4.57	3.15	3.15	352.0
362.0	2.66	3.39	3.70	3.42	3.44	2.66	90.0
371.0	4.33	6.32	5.87	3.46	3.28	3.28	352.0
383.0	4.17	2.68	3.35	2.71	4.01	2.68	154.0
397.0	3.44	3.31	2.85	3.22	3.65	2.85	222.0
403.0	5.18	4.44	5.89	4.01	5.99	4.01	286.0

SEGMENT MINIMUM = 2.15 AT THE 263.0 INCH STATION

C-4

Table 10

RSRM-21A FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76666-02
SERIAL NO. 0000016

STATION (IN)	74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN	MDT
	DEGREE LOCATIONS							
3.5	2.583	2.517	2.556	2.502	2.573	2.502	2.556	2.120
13.0	0.890	0.927	0.937	0.981	0.892	0.890	0.927	0.650
27.0	0.597	0.614	0.653	0.617	0.611	0.597	0.614	0.450
44.0	0.303	0.299	0.298	0.301	0.297	0.297	0.299	0.250
60.0	0.141	0.138	0.137	0.150	0.151	0.137	0.141	0.100
94.7	0.111	0.110	0.107	0.115	0.114	0.107	0.111	0.090
142.0	0.164	0.165	0.166	0.169	0.168	0.164	0.166	0.113
152.0	0.396	0.386	0.392	0.382	0.398	0.382	0.392	0.317
162.0	0.760	0.753	0.780	0.731	0.751	0.731	0.753	0.547
175.5	0.690	0.686	0.696	0.669	0.679	0.669	0.686	0.604
187.0	0.670	0.649	0.665	0.660	0.668	0.649	0.665	0.640
199.0	0.742	0.773	0.763	0.727	0.747	0.727	0.747	0.683
213.0	0.734	0.725	0.748	0.721	0.740	0.721	0.734	0.677
224.0	0.799	0.814	0.798	0.758	0.802	0.758	0.799	0.677
230.0	0.723	0.729	0.739	0.716	0.726	0.716	0.726	0.677
236.0	0.644	0.684	0.681	0.673	0.668	0.644	0.673	0.578
240.0	0.644	0.650	0.684	0.664	0.676	0.644	0.664	0.574
254.0	0.665	0.698	0.650	0.660	0.667	0.650	0.665	0.568
263.0	0.597	0.598	0.612	0.594	0.592	0.592	0.597	0.568
282.0	0.645	0.651	0.654	0.636	0.656	0.636	0.651	0.564
293.0	0.632	0.619	0.651	0.638	0.630	0.619	0.632	0.546
305.0	0.666	0.658	0.669	0.702	0.706	0.658	0.669	0.525
312.0	0.666	0.641	0.642	0.676	0.693	0.641	0.666	0.541
321.0	1.129	1.145	1.044	1.071	1.100	1.044	1.100	0.918
339.0	0.580	0.603	0.588	0.578	0.584	0.578	0.584	0.551
350.0	0.621	0.597	0.614	0.581	0.663	0.581	0.614	0.523
362.0	0.624	0.594	0.592	0.574	0.603	0.574	0.594	0.520
371.0	0.623	0.603	0.593	0.650	0.661	0.593	0.623	0.520
383.0	0.589	0.612	0.581	0.595	0.635	0.581	0.595	0.511
397.0	0.610	0.594	0.588	0.595	0.577	0.577	0.594	0.503
403.0	1.147	1.097	1.138	1.134	1.083	1.083	1.134	0.950

POSTFIRE MEASUREMENTS
INCHES

PART NO. 1U76790-05
SERIAL NO. 0000005

STATION (IN)	74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN
	DEGREE LOCATIONS						
3.5	2.467	2.440	2.501	2.435	2.490	2.435	2.467
13.0	0.830	0.881	0.825	0.901	0.839	0.825	0.839
27.0	L	L	L	L	L	L	0.614
44.0	L	L	L	L	L	L	0.299
60.0	L	L	L	L	L	L	0.141
94.7	L	L	L	L	L	L	0.111
142.0	L	L	L	L	L	L	0.166
152.0	0.373	0.365	0.384	0.356	0.340	0.340	0.365
162.0	0.660	0.669	0.644	0.657	0.669	0.644	0.660
175.5	0.565	0.543	0.559	0.515	0.552	0.515	0.552
187.0	0.498	0.526	0.528	0.488	0.523	0.488	0.523
199.0	0.605	0.599	0.559	0.580	0.605	0.559	0.599
213.0	0.602	0.615	0.600	0.602	0.614	0.600	0.602
224.0	0.667	0.630	0.675	0.669	0.644	0.630	0.667
230.0	0.580	0.603	0.647	0.588	0.600	0.580	0.600
236.0	0.490	0.526	0.555	0.526	0.528	0.490	0.526
240.0	0.509	0.498	0.549	0.538	0.516	0.498	0.516
254.0	0.520	0.546	0.504	0.518	0.516	0.504	0.518
263.0	0.466	0.451	0.468	0.446	0.445	0.445	0.451
282.0	0.521	0.496	0.519	0.526	0.518	0.496	0.519
293.0	0.490	0.509	0.513	0.491	0.459	0.459	0.491
305.0	0.513	0.545	0.538	0.529	0.578	0.513	0.538
312.0	0.523	0.534	0.494	0.502	0.531	0.494	0.523
321.0	0.865	0.888	0.908	0.840	0.973	0.840	0.888
339.0	0.478	0.421	0.474	0.443	0.458	0.421	0.458
350.0	0.456	0.459	0.484	0.449	0.504	0.449	0.459
362.0	0.459	0.419	0.428	0.444	0.420	0.419	0.428
371.0	0.510	0.481	0.454	0.497	0.454	0.454	0.481
383.0	0.457	0.435	0.456	0.437	0.462	0.435	0.456
397.0	0.436	0.455	0.467	0.388	0.403	0.388	0.436
403.0	0.917	0.863	0.910	0.863	0.877	0.863	0.877

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 10

RSRM-21A FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.116<	0.077	0.055	0.067	0.083	0.077	0.116	0.103
13.0	0.060	0.046	0.112<	0.080	0.053	0.060	0.112	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
0.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.023	0.021	0.008	0.026	0.058	0.023	0.058	0.123
162.0	0.100	0.084	0.136	0.074	0.082	0.084	0.136	0.227
175.5	0.125	0.143	0.137	0.154	0.127	0.137	0.154	0.324
187.0	0.172	0.123	0.137	0.172	0.145	0.145	0.172	0.398
199.0	0.137	0.174	0.204	0.147	0.142	0.147	0.204	0.427
213.0	0.132	0.110	0.148	0.119	0.126	0.126	0.148	0.423
224.0	0.132	0.184	0.123	0.089	0.158	0.132	0.184	0.422
230.0	0.143	0.126	0.092	0.128	0.126	0.126	0.143	0.375
236.0	0.154	0.158	0.126	0.147	0.140	0.147	0.158	0.327
240.0	0.135	0.152	0.135	0.126	0.160	0.135	0.160	0.342
254.0	0.145	0.152	0.146	0.142	0.151	0.146	0.152	0.318
263.0	0.131	0.147	0.144	0.148	0.147	0.147	0.148	0.334
282.0	0.124	0.155	0.135	0.110	0.138	0.135	0.155	0.349
293.0	0.142	0.110	0.138	0.147	0.171	0.142	0.171	0.330
305.0	0.183	0.113	0.131	0.173	0.128	0.131	0.173	0.309
312.0	0.143	0.107	0.148	0.174	0.162	0.148	0.174	0.308
321.0	0.264	0.257	0.136	0.231	0.127	0.231	0.264	0.434
339.0	0.102	0.182	0.114	0.135	0.126	0.126	0.182	0.319
350.0	0.165	0.138	0.130	0.132	0.159	0.138	0.165	0.300
362.0	0.165	0.175	0.164	0.130	0.183	0.165	0.183	0.285
371.0	0.113	0.122	0.139	0.153	0.207	0.139	0.207	0.304
383.0	0.132	0.177	0.125	0.158	0.173	0.158	0.177	0.295
397.0	0.174	0.139	0.121	0.207	0.174	0.174	0.207	0.287
403.0	0.230	0.234	0.228	0.271	0.206	0.230	0.271	0.287

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	AVE.	EXPOSURE TIME
3.5	3.3	2.2	1.6	1.9	2.4	2.3	34.9
13.0	3.0	2.3	5.7	4.1	2.7	3.6	19.7
27.0	0	0	0	0	0	0	4.9
44.0	0	0	0	0	0	0	3.0
60.0	0	0	0	0	0	0	1.4
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	1.1	1.0	0.4	1.2	2.7	1.3	21.1
162.0	2.2	1.9	3.0	1.6	1.8	2.1	45.0
175.5	1.8	2.1	2.0	2.2	1.8	2.0	69.3
187.0	2.5	1.8	2.0	2.5	2.1	2.2	67.5
199.0	2.0	2.6	3.0	2.2	2.1	2.4	67.5
213.0	2.0	1.6	2.2	1.8	1.9	1.9	67.5
224.0	2.0	2.7	1.8	1.3	2.3	2.0	67.5
230.0	2.1	1.9	1.4	1.9	1.9	1.8	67.5
236.0	2.3	2.3	1.9	2.2	2.1	2.1	67.5
240.0	2.0	2.3	2.0	1.9	2.4	2.1	67.5
254.0	2.1	2.3	2.2	2.1	2.2	2.2	67.5
263.0	1.9	2.2	2.1	2.2	2.2	2.1	67.5
282.0	1.8	2.3	2.0	1.6	2.0	2.0	67.5
293.0	2.1	1.6	2.0	2.2	2.5	2.1	67.5
305.0	2.3	1.7	1.9	2.6	1.9	2.1	67.5
312.0	2.1	1.6	2.2	2.6	2.4	2.2	67.5
321.0	3.7	3.6	1.9	3.2	1.8	2.8	72.0
339.0	1.4	2.5	1.5	1.8	1.7	1.8	74.0
350.0	2.1	1.8	1.7	1.7	2.0	1.9	77.9
362.0	2.0	2.1	2.0	1.6	2.2	2.0	82.9
371.0	1.4	1.5	1.7	1.8	2.5	1.8	83.3
383.0	1.5	1.9	1.4	1.7	1.9	1.7	90.8
397.0	1.8	1.4	1.2	2.1	1.8	1.6	99.1
403.0	1.8	1.9	1.8	2.2	1.6	1.9	124.9

MOTOR ACTION TIME = 124.9 SECONDS

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

Table 10

RSRM-21A FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE	REQUIRED S.F.
3.5	18.28	27.83	38.55	31.64	25.54	18.28	74.0	2.0
13.0	10.83	14.13	5.80	8.13	12.26	5.80	206.0	1.5
27.0	+	+	+	+	+	+	74.0	1.5
44.0	+	+	+	+	+	+	74.0	1.5
60.0	+	+	+	+	+	+	74.0	1.5
94.7	+	+	+	+	+	+	74.0	1.5
142.0	+	+	+	+	+	+	74.0	1.5
152.0	13.78	15.10	39.63	12.19	5.47	5.47	336.0	1.5
162.0	5.47	6.51	4.02	7.39	6.67	4.02	206.0	2.0
175.5	4.83	4.22	4.41	3.92	4.76	3.92	270.0	1.5
187.0	3.72	5.20	4.67	3.72	4.41	3.72	74.0	1.5
199.0	4.99	3.93	3.35	4.65	4.81	3.35	206.0	1.5
213.0	5.13	6.15	4.57	5.69	5.37	4.57	206.0	1.5
224.0	5.13	3.68	5.50	7.61	4.28	3.68	140.0	1.5
230.0	4.73	5.37	7.36	5.29	5.37	4.73	74.0	1.5
236.0	3.75	3.66	4.59	3.93	4.13	3.66	140.0	1.5
240.0	4.25	3.78	4.25	4.56	3.59	3.59	336.0	1.5
254.0	3.92	3.74	3.89	4.00	3.76	3.74	140.0	1.5
263.0	4.34	3.86	3.94	3.84	3.86	3.84	270.0	1.5
282.0	4.58	3.66	4.21	5.16	4.12	3.66	140.0	1.5
293.0	3.85	4.96	3.86	3.71	3.19	3.19	336.0	1.5
305.0	3.43	4.65	4.01	3.03	4.10	3.03	270.0	1.5
312.0	3.78	5.06	3.66	3.11	3.34	3.11	270.0	1.5
321.0	3.48	3.87	6.75	3.97	7.23	3.48	74.0	2.0
339.0	5.40	3.03	4.83	4.08	4.37	3.03	140.0	1.5
350.0	3.17	3.79	4.02	3.86	3.29	3.17	74.0	1.5
362.0	3.15	2.97	3.17	4.00	2.84	2.84	336.0	1.5
371.0	4.60	4.26	3.74	3.40	2.51	2.51	336.0	1.5
383.0	3.87	2.89	4.09	3.23	2.95	2.89	140.0	1.5
397.0	2.89	3.62	4.16	2.43	2.89	2.43	270.0	1.5
403.0	4.13	4.06	4.17	3.51	4.61	3.51	270.0	1.5

SEGMENT MINIMUM = 2.43 AT THE 397.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE
3.5	22.27	32.69	46.47	37.34	31.00	22.27	74.0
13.0	14.83	20.15	8.37	12.26	16.83	8.37	206.0
27.0	+	+	+	+	+	+	74.0
44.0	+	+	+	+	+	+	74.0
60.0	+	+	+	+	+	+	74.0
94.7	+	+	+	+	+	+	74.0
142.0	+	+	+	+	+	+	74.0
152.0	17.22	18.38	49.00	14.69	6.86	6.86	336.0
162.0	7.60	8.96	5.74	9.88	9.16	5.74	206.0
175.5	5.52	4.80	5.08	4.34	5.35	4.34	270.0
187.0	3.90	5.28	4.85	3.84	4.61	3.84	270.0
199.0	5.42	4.44	3.74	4.95	5.26	3.74	206.0
213.0	5.56	6.59	5.05	6.06	5.87	5.05	206.0
224.0	6.05	4.42	6.49	8.52	5.08	4.42	140.0
230.0	5.06	5.79	8.03	5.59	5.76	5.06	74.0
236.0	4.18	4.33	5.40	4.58	4.77	4.18	74.0
240.0	4.77	4.28	5.07	5.27	4.22	4.22	336.0
254.0	4.59	4.59	4.45	4.65	4.42	4.42	336.0
263.0	4.56	4.07	4.25	4.01	4.03	4.01	270.0
282.0	5.20	4.20	4.84	5.78	4.75	4.20	140.0
293.0	4.45	5.63	4.72	4.34	3.68	3.68	336.0
305.0	4.35	5.82	5.11	4.06	5.52	4.06	270.0
312.0	4.66	5.99	4.34	3.89	4.28	3.89	270.0
321.0	4.28	4.46	7.68	4.64	8.66	4.28	74.0
339.0	5.69	3.31	5.16	4.28	4.63	3.31	140.0
350.0	3.76	4.33	4.72	4.40	4.17	3.76	74.0
362.0	3.78	3.39	3.61	4.42	3.30	3.30	336.0
371.0	5.51	4.94	4.27	4.25	3.19	3.19	336.0
383.0	4.46	3.46	4.65	3.77	3.67	3.46	140.0
397.0	3.51	4.27	4.86	2.87	3.32	2.87	270.0
403.0	4.99	4.69	4.99	4.18	5.26	4.18	270.0

SEGMENT MINIMUM = 2.87 AT THE 397.0 INCH STATION

Table 11

RSRM-21B NOZZLE TO CASE JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
0.0	5.661	4.670	0.991	4.9	5.7
21.6	5.664	4.816	0.848	5.8	6.7
46.8	5.658	4.782	0.876	5.6	6.5
68.4	5.658	4.794	0.864	5.7	6.5
90.0	5.650	4.920	0.730	6.7	7.7
111.6	5.658	4.356	1.302	3.8	4.3
136.8	5.669	4.974	0.695	7.1	8.2
158.4	5.654	4.904	0.750	6.5	7.5
180.0	5.660	4.886	0.774	6.3	7.3
201.6	5.656	4.792	0.864	5.7	6.5
226.8	5.662	4.854	0.808	6.1	7.0
248.4	5.654	4.918	0.736	6.7	7.7
270.0	5.670	5.129	0.541	9.1	10.5
291.6	5.669	4.899	0.770	6.4	7.4
316.8	5.656	5.110	0.546	9.0	10.4
338.4	5.668	5.004	0.664	7.4	8.5
	MEDIAN	MEDIAN	MEDIAN	MINIMUM	MINIMUM
	5.659	4.893	0.772	3.8	4.3

A SAFETY FACTOR OF 2.0 IS REQUIRED

TABLE 12

RSRM-21B AFT FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.761	2.271	0.490	5.3	5.6
16.0	2.765	2.324	0.441	5.9	6.3
30.0	2.769	2.299	0.470	5.5	5.9
46.0	2.780	2.280	0.500	5.2	5.6
60.0	2.775	2.305	0.470	5.5	5.9
76.0	2.767	2.318	0.449	5.8	6.2
90.0	2.773	2.311	0.462	5.6	6.0
106.0	2.777	2.312	0.465	5.6	6.0
120.0	2.780	2.311	0.469	5.5	5.9
136.0	2.778	2.318	0.460	5.6	6.0
150.0	2.780	2.345	0.435	6.0	6.4
166.0	2.768	2.362	0.406	6.4	6.8
180.0	2.767	2.422	0.345	7.5	8.0
196.0	2.765	2.385	0.380	6.8	7.3
210.0	2.762	2.350	0.412	6.3	6.7
226.0	2.757	2.287	0.470	5.5	5.9
242.0	2.761	2.314	0.447	5.8	6.2
256.0	2.753	2.288	0.465	5.6	5.9
270.0	2.759	2.282	0.477	5.4	5.8
286.0	2.760	2.298	0.462	5.6	6.0
300.0	2.758	2.315	0.443	5.9	6.2
316.0	2.755	2.278	0.477	5.4	5.8
330.0	2.750	2.333	0.417	6.2	6.6
346.0	2.764	2.307	0.457	5.7	6.0
	MEDIAN	MEDIAN	MEDIAN	MINIMUM	MINIMUM
	2.765	2.312	0.461	5.2	5.6

A SAFETY FACTOR OF 2.0 IS REQUIRED

Table 13
RSRM-21B CENTER FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.766	2.572	0.194	13.4	14.3
16.0	2.686	2.556	0.130	20.0	20.7
30.0	2.684	2.545	0.139	18.7	19.3
46.0	2.688	2.493	0.195	13.3	13.8
60.0	2.685	2.445	0.240	10.8	11.2
76.0	2.684	2.524	0.160	16.2	16.8
90.0	2.683	2.538	0.145	17.9	18.5
106.0	2.690	2.562	0.128	20.3	21.0
120.0	2.684	2.588	0.096	27.0	28.0
136.0	2.686	2.579	0.107	24.3	25.1
150.0	2.690	2.589	0.101	25.7	26.6
166.0	2.688	2.592	0.096	27.0	28.0
180.0	2.743	2.614	0.129	20.1	21.3
196.0	2.735	2.574	0.161	16.1	17.0
210.0	2.722	2.601	0.121	21.4	22.5
226.0	2.732	2.581	0.151	17.2	18.1
242.0	2.720	2.586	0.134	19.4	20.3
256.0	2.714	2.595	0.119	21.8	22.8
270.0	2.717	2.598	0.119	21.8	22.8
286.0	2.714	2.571	0.143	18.1	19.0
300.0	2.729	2.594	0.135	19.2	20.2
316.0	2.700	2.574	0.126	20.6	21.4
330.0	2.706	2.596	0.110	23.6	24.6
346.0	2.699	2.556	0.143	18.1	18.9
	MEDIAN	MEDIAN	MEDIAN	MINIMUM	MINIMUM
	2.700	2.576	0.132	10.8	11.2

A SAFETY FACTOR OF 2.0 IS REQUIRED

Table 14

RSRM-21B FORWARD FIELD JOINT PERFORMANCE

DEGREE LOCATION	PREFIRE (INCHES)	POSTFIRE (INCHES)	MDD	CSF	ASF
2.0	2.796	2.588	0.208	12.5	13.4
16.0	2.800	2.600	0.200	13.0	14.0
30.0	2.796	2.593	0.203	12.8	13.8
46.0	2.787	2.567	0.220	11.8	12.7
60.0	2.779	2.580	0.199	13.0	14.0
76.0	2.788	2.608	0.180	14.4	15.5
90.0	2.797	2.581	0.216	12.0	12.9
106.0	2.793	2.577	0.216	12.0	12.9
120.0	2.791	2.592	0.199	13.0	14.0
136.0	2.770	2.612	0.158	16.4	17.5
150.0	2.788	2.603	0.185	14.0	15.1
166.0	2.780	2.578	0.202	12.8	13.8
180.0	2.771	2.627	0.144	18.0	19.2
196.0	2.778	2.581	0.197	13.2	14.1
210.0	2.770	2.587	0.183	14.2	15.1
226.0	2.778	2.580	0.198	13.1	14.0
242.0	2.770	2.590	0.180	14.4	15.4
256.0	2.778	2.584	0.194	13.4	14.3
270.0	2.766	2.582	0.184	14.1	15.0
286.0	2.763	2.623	0.140	18.5	19.7
300.0	2.773	2.628	0.145	17.9	19.1
316.0	2.758	2.566	0.192	13.5	14.4
330.0	2.762	2.598	0.164	15.8	16.8
346.0	2.779	2.580	0.199	13.0	14.0
	MEDIAN	MEDIAN	MEDIAN	MINIMUM	MINIMUM
	2.779	2.588	0.196	11.8	12.7

A SAFETY FACTOR OF 2.0 IS REQUIRED

Table 15
RSRM-21B AFT DOME INSULATION PERFORMANCE

PART NO. 1U76668-06
SERIAL NO. 0000004

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
	DEGREE LOCATIONS										
9.3	5.311	5.273	5.305	5.307	5.338	5.313	5.346	5.281	5.273	5.309	4.900
10.7	5.140	5.065	5.148	5.076	5.124	5.104	5.167	5.058	5.058	5.114	4.700
12.0	4.935	4.895	4.975	4.904	4.949	4.935	4.965	4.876	4.876	4.935	4.500
13.1	4.764	4.730	4.794	4.713	4.772	4.724	4.790	4.689	4.689	4.747	4.300
14.4	4.445	4.415	4.483	4.395	4.435	4.397	4.458	4.380	4.380	4.425	4.100
16.0	4.201	4.166	4.219	4.148	4.181	4.142	4.218	4.123	4.123	4.174	3.780
17.3	4.077	4.042	4.113	4.033	4.064	4.031	4.099	4.018	4.018	4.053	3.560
18.5	3.932	3.898	4.001	3.890	3.929	3.809	3.950	3.855	3.855	3.919	3.360
19.5	3.740	3.717	3.827	3.728	3.754	3.726	3.768	3.704	3.704	3.734	3.150
21.3	3.480	3.459	3.551	3.464	3.490	3.483	3.536	3.451	3.451	3.482	2.940
24.3	3.390	3.373	3.481	3.374	3.384	3.390	3.456	3.353	3.353	3.387	2.940
33.0	3.458	3.409	3.472	3.526	3.448	3.493	3.451	3.464	3.409	3.461	3.200
45.0	2.830	2.814	2.888	2.832	2.714	2.724	2.758	2.801	2.714	2.808	2.600
53.0	3.595	3.632	3.742	3.633	3.611	3.668	3.680	3.690	3.595	3.651	3.380
56.0	3.218	3.235	3.328	3.217	3.229	3.305	3.280	3.345	3.217	3.257	2.790
72.0	2.081	2.074	2.105	2.117	2.035	2.033	2.194	2.081	2.033	2.081	2.000
75.0	1.862	1.858	1.913	1.881	1.868	1.861	1.987	1.902	1.858	1.875	1.800
78.0	1.623	1.644	1.651	1.672	1.619	1.644	1.783	1.688	1.619	1.648	1.600

PART NO. 1U76957-03
SERIAL NO. 0000006

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
	DEGREE LOCATIONS									
9.3	4.204	4.162	4.150	4.139	4.433	4.144	4.120	4.198	4.120	4.156
10.7	4.088	4.057	4.178	4.112	4.434	4.166	3.953	4.068	3.953	4.100
12.0	3.967	3.888	4.056	3.975	4.194	4.040	3.843	3.868	3.843	3.971
13.1	3.745	3.751	3.867	3.798	3.999	3.833	3.716	3.647	3.647	3.775
14.4	3.621	3.532	3.578	3.578	3.651	3.518	3.452	3.412	3.412	3.555
16.0	3.459	3.438	3.433	3.399	3.455	3.356	3.314	3.218	3.218	3.416
17.3	3.462	3.457	3.437	3.366	3.299	3.285	3.286	3.300	3.285	3.333
18.5	3.456	3.375	3.484	3.333	3.393	3.305	3.307	3.297	3.297	3.354
19.5	3.336	3.210	3.315	3.134	3.167	3.241	3.187	3.133	3.133	3.199
21.3	3.062	3.028	3.021	2.985	2.996	2.914	3.022	2.934	2.914	3.009
24.3	2.687	2.716	2.779	2.783	2.816	2.661	2.678	2.711	2.661	2.714
33.0	2.278	2.313	2.184	2.317	2.311	2.242	2.385	2.219	2.184	2.295
45.0	1.822	1.818	1.738	1.716	1.636	1.668	1.689	1.752	1.636	1.727
53.0	2.740	2.733	2.754	2.574	2.682	2.669	2.843	2.693	2.574	2.713
56.0	2.560	2.531	2.658	2.572	2.496	2.523	2.718	2.650	2.496	2.566
72.0	1.674	1.634	1.602	1.577	1.582	1.759	1.725	1.664	1.577	1.649
75.0	1.508	1.450	1.430	1.408	1.440	1.561	1.482	1.486	1.408	1.466
78.0	1.259	1.245	1.215	1.245	1.250	1.359	1.250	1.231	1.215	1.248

Table 15

RSRM-21B AFT DOME INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MEDIAN	MAX.	DESIGN M+3S
9.3	1.107	1.111	1.155	1.168	0.905	1.169	1.226	1.083	1.133	1.226	2.560
10.7	1.052	1.008	0.970	0.964	0.690	0.938	1.214	0.990	0.980	1.214	2.261
12.0	0.968	1.007	0.919	0.929	0.755	0.895	1.122	1.008	0.948	1.122	2.208
13.1	1.019	0.979	0.927	0.915	0.773	0.891	1.074	1.042	0.953	1.074	2.218
14.4	0.824	0.883	0.905	0.817	0.784	0.879	1.006	0.968	0.881	1.006	2.225
16.0	0.742	0.728	0.786	0.749	0.726	0.786	0.904	0.905	0.767	0.905	1.980
17.3	0.615	0.585	0.676	0.667	0.765	0.746	0.813	0.718	0.697	0.813	1.675
18.5	0.476	0.523	0.517	0.557	0.536	0.604	0.643	0.558	0.547	0.643	1.496
19.5	0.404	0.507	0.512	0.594	0.587	0.485	0.581	0.571	0.541	0.594	1.617
21.3	0.418	0.431	0.530	0.479	0.494	0.569	0.514	0.517	0.504	0.569	1.654
24.3	0.703	0.657	0.702	0.591	0.568	0.729	0.778	0.642	0.679	0.778	1.832
33.0	1.180	1.096	1.288	1.209	1.137	1.251	1.066	1.245	1.194	1.288	1.399
45.0	1.008	0.996	1.150	1.116	1.078	1.056	1.069	1.049	1.063	1.150	1.222
53.0	0.855	0.899	0.988	1.059	0.929	0.999	0.837	0.997	0.959	1.059	1.305
56.0	0.658	0.704	0.670	0.645	0.733	0.782	0.562	0.695	0.683	0.782	1.369
72.0	0.407	0.440	0.503	0.540	0.453	0.274	0.469	0.417	0.447	0.540	0.817
75.0	0.354	0.408	0.483	0.473	0.428	0.300	0.505	0.416	0.422	0.505	0.773
78.0	0.364	0.399	0.436	0.427	0.369	0.285	0.533	0.457	0.413	0.533	0.718

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	AVE.	EXPOSURE TIME
9.3	8.9	8.9	9.2	9.3	7.2	9.4	9.8	8.7	8.9	125.0
10.7	8.6	8.2	7.9	7.9	5.6	7.6	9.9	8.1	8.0	122.7
12.0	8.1	8.4	7.7	7.8	6.3	7.5	9.4	8.4	7.9	119.7
13.1	8.7	8.4	7.9	7.8	6.6	7.6	9.2	8.9	8.2	116.8
14.4	7.2	7.7	7.9	7.2	6.9	7.7	8.8	8.5	7.7	114.0
16.0	6.7	6.6	7.1	6.8	6.5	7.1	8.2	8.2	7.1	110.9
17.3	5.7	5.4	6.3	6.2	7.1	6.9	7.5	6.7	6.5	107.8
18.5	4.5	5.0	4.9	5.3	5.1	5.7	6.1	5.3	5.2	105.6
19.5	3.9	4.9	4.9	5.7	5.7	4.7	5.6	5.5	5.1	103.5
21.3	4.2	4.3	5.3	4.8	4.9	5.7	5.1	5.2	4.9	100.1
24.3	7.3	6.8	7.3	6.2	5.9	7.6	8.1	6.7	7.0	96.0
33.0	13.8	12.8	15.0	14.1	13.3	14.6	12.5	14.5	13.8	85.6
45.0	13.1	13.0	15.0	14.5	14.0	13.7	13.9	13.7	13.9	76.8
53.0	11.2	11.8	12.9	13.9	12.2	13.1	11.0	13.0	12.4	76.4
56.0	8.6	9.2	8.8	8.5	9.6	10.3	7.4	9.1	8.9	76.2
72.0	7.0	7.6	8.7	9.3	7.8	4.7	8.1	7.2	7.6	57.8
75.0	6.8	7.9	9.3	9.1	8.2	5.8	9.7	8.0	8.1	51.9
78.0	7.6	8.4	9.2	9.0	7.8	6.0	11.2	9.6	8.6	47.6

MOTOR ACTION TIME = 125.8 SECONDS

Table 15
RSRM-21B AFT DOME INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	PLANE	REQUIRED S.F.
9.3	4.43	4.41	4.24	4.20	5.41	4.19	4.00	4.52	4.00	270.0	1.5
10.7	4.47	4.66	4.85	4.88	6.81	5.01	3.87	4.75	3.87	270.0	1.5
12.0	4.65	4.47	4.90	4.84	5.96	5.03	4.01	4.46	4.01	270.0	1.5
13.1	4.22	4.39	4.64	4.70	5.56	4.83	4.00	4.13	4.00	270.0	1.5
14.4	4.98	4.64	4.53	5.02	5.23	4.66	4.08	4.24	4.08	270.0	1.5
16.0	5.09	5.19	4.81	5.05	5.21	4.81	4.18	4.18	4.18	316.8	1.5
17.3	5.79	6.09	5.27	5.34	4.65	4.77	4.38	4.96	4.38	270.0	1.5
18.5	7.06	6.42	6.50	6.03	6.27	5.56	5.23	6.02	5.23	270.0	1.5
19.5	7.80	6.21	6.15	5.30	5.37	6.49	5.42	5.52	5.30	136.8	1.5
21.3	7.03	6.82	5.55	6.14	5.95	5.17	5.72	5.69	5.17	226.8	1.5
24.3	4.18	4.47	4.19	4.97	5.18	4.03	3.78	4.58	3.78	270.0	1.5
33.0	2.71	2.92	2.48	2.65	2.81	2.56	3.00	2.57	2.48	90.0	1.5
45.0	2.58	2.61	2.26	2.33	2.41	2.46	2.43	2.48	2.26	90.0	1.5
53.0	3.95	3.76	3.42	3.19	3.64	3.38	4.04	3.39	3.19	136.8	1.5
56.0	4.24	3.96	4.16	4.33	3.81	3.57	4.96	4.01	3.57	226.8	2.0
72.0	4.91	4.55	3.98	3.70	4.42	7.30	4.26	4.80	3.70	136.8	1.5
75.0	5.08	4.41	3.73	3.81	4.21	6.00	3.56	4.33	3.56	270.0	1.5
78.0	4.40	4.01	3.67	3.75	4.34	5.61	3.00	3.50	3.00	270.0	1.5

SEGMENT MINIMUM = 2.26 AT THE 45.0 INCH STATION

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	PLANE	REQUIRED S.F.
9.3	4.80	4.75	4.59	4.54	5.90	4.54	4.36	4.88	4.36	270.0	1.5
10.7	4.89	5.02	5.31	5.27	7.43	5.44	4.26	5.11	4.26	270.0	1.5
12.0	5.10	4.86	5.41	5.28	6.55	5.51	4.43	4.84	4.43	270.0	1.5
13.1	4.68	4.83	5.17	5.15	6.17	5.30	4.46	4.50	4.46	270.0	1.5
14.4	5.39	5.00	4.95	5.38	5.66	5.00	4.43	4.52	4.43	270.0	1.5
16.0	5.66	5.72	5.37	5.54	5.76	5.27	4.67	4.56	4.56	316.8	1.5
17.3	6.63	6.91	6.08	6.05	5.31	5.40	5.04	5.60	5.04	270.0	1.5
18.5	8.26	7.45	7.74	6.98	7.13	6.47	6.14	6.91	6.14	270.0	1.5
19.5	9.26	7.33	7.47	6.28	6.40	7.68	6.49	6.49	6.28	136.8	1.5
21.3	8.33	8.03	6.70	7.23	7.06	6.12	6.88	6.68	6.12	226.8	1.5
24.3	4.82	5.13	4.96	5.71	5.96	4.65	4.44	5.22	4.44	270.0	1.5
33.0	2.93	3.11	2.70	2.92	3.03	2.79	3.24	2.78	2.70	90.0	1.5
45.0	2.81	2.83	2.51	2.54	2.52	2.58	2.58	2.67	2.51	90.0	1.5
53.0	4.20	4.04	3.79	3.43	3.89	3.67	4.40	3.70	3.43	136.8	1.5
56.0	4.89	4.60	4.97	4.99	4.41	4.23	5.84	4.81	4.23	226.8	2.0
72.0	5.11	4.71	4.18	3.92	4.49	7.42	4.68	4.99	3.92	136.8	1.5
75.0	5.26	4.55	3.96	3.98	4.36	6.20	3.93	4.57	3.93	270.0	1.5
78.0	4.46	4.12	3.79	3.92	4.39	5.77	3.35	3.69	3.35	270.0	1.5

SEGMENT MINIMUM = 2.51 AT THE 45.0 INCH STATION

Table 16

RSRM-21B AFT CYLINDER INSULATION PERFORMANCE

PART NO. 1U76668-06
SERIAL NO. 0000004

PREFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN	MDT
85.0	1.518	1.503	1.528	1.512	1.580	1.525	1.505	1.533	1.503	1.521	1.300
90.0	1.420	1.417	1.430	1.427	1.438	1.405	1.404	1.449	1.404	1.424	1.265
98.0	1.348	1.374	1.366	1.358	1.400	1.336	1.346	1.375	1.336	1.362	1.135
105.8	1.098	1.145	1.108	1.121	1.138	1.086	1.080	1.097	1.080	1.103	1.080
116.0	1.124	1.067	1.098	1.082	1.092	1.063	1.051	1.060	1.051	1.075	1.050
124.5	1.075	1.045	1.091	1.038	1.071	1.046	1.040	1.050	1.038	1.048	1.030
133.0	1.135	1.149	1.148	1.151	1.142	1.103	1.102	1.143	1.102	1.143	0.980
145.5	0.913	0.931	0.924	0.944	0.945	0.930	0.909	0.904	0.904	0.927	0.930
158.5	0.895	0.910	0.910	0.905	0.923	0.881	0.880	0.885	0.880	0.900	0.880
166.0	0.969	0.978	0.970	0.967	0.975	0.945	0.980	0.940	0.940	0.970	0.850
177.7	1.463	1.480	1.479	1.502	1.494	1.475	1.479	1.488	1.463	1.480	1.000
192.5	0.929	0.938	0.930	0.922	0.880	0.942	0.914	0.930	0.880	0.930	0.780
202.5	0.740	0.730	0.741	0.735	0.737	0.731	0.722	0.730	0.722	0.733	0.730
214.0	0.701	0.704	0.705	0.700	0.701	0.700	0.704	0.700	0.700	0.701	0.700
227.3	0.771	0.788	0.755	0.710	0.744	0.767	0.775	0.782	0.710	0.769	0.650
238.3	0.632	0.630	0.631	0.630	0.646	0.616	0.632	0.630	0.616	0.631	0.630
250.0	0.561	0.555	0.554	0.558	0.552	0.550	0.550	0.555	0.550	0.555	0.550
269.0	0. 71	0.588	0.558	0.554	0.561	0.568	0.572	0.570	0.554	0.569	0.500
283.9	0.520	0.494	0.503	0.489	0.495	0.473	0.497	0.487	0.473	0.495	0.450
299.1	1.019	1.083	1.032	1.049	1.075	1.088	1.044	1.022	1.019	1.047	0.676
322.0	0.415	0.416	0.415	0.416	0.412	0.418	0.413	0.422	0.412	0.416	0.380
339.0	0.415	0.420	0.414	0.413	0.415	0.424	0.411	0.423	0.411	0.415	0.380
358.0	0.425	0.428	0.416	0.421	0.412	0.411	0.420	0.415	0.411	0.418	0.380
367.0	0.468	0.490	0.491	0.490	0.494	0.470	0.473	0.468	0.468	0.481	0.380
377.5	0.666	0.700	0.692	0.647	0.763	0.719	0.775	0.691	0.647	0.696	0.530

Table 16
RSRM-21B AFT CYLINDER INSULATION PERFORMANCE

PART NO. 1U76957-03
SERIAL NO. 0000006

POSTFIRE MEASUREMENTS
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	MEDIAN
85.0	1.184	1.157	1.155	1.131	1.125	1.244	1.132	1.141	1.125	1.148
90.0	1.058	1.022	1.040	1.002	1.005	1.008	1.002	1.032	1.002	1.015
98.0	0.944	0.982	0.924	0.960	0.902	0.913	0.923	0.943	0.902	0.934
105.8	0.707	0.881	0.688	0.673	0.621	0.635	0.640	0.661	0.621	0.667
116.0	0.691	0.874	0.722	0.677	0.628	0.645	0.669	0.688	0.628	0.683
124.5	0.691	0.704	0.707	0.673	0.608	0.635	0.643	0.686	0.608	0.679
133.0	0.760	0.854	0.736	0.693	0.699	0.688	0.728	0.739	0.688	0.728
145.5	0.558	0.568	0.517	0.448	0.513	0.492	0.526	0.565	0.448	0.522
158.5	0.558	0.563	0.537	0.490	0.506	0.519	0.550	0.521	0.490	0.529
166.0	0.636	0.686	0.657	0.613	0.629	0.583	0.701	0.637	0.583	0.637
177.7	1.109	1.227	1.146	1.134	1.074	1.119	1.119	1.138	1.074	1.127
192.5	0.6[illegible]	0.636	0.632	0.605	0.615	0.624	0.611	0.636	0.605	0.628
202.5	0.462	0.510	0.473	0.437	0.448	0.453	0.473	0.490	0.437	0.468
214.0	0.452	0.426	0.457	0.406	0.413	0.406	0.437	0.450	0.406	0.432
227.3	0.546	0.559	0.509	0.465	0.438	0.449	0.496	0.522	0.438	0.502
238.3	0.450	0.408	0.421	0.369	0.398	0.414	0.430	0.440	0.369	0.418
250.0	0.359	0.342	0.353	0.322	0.317	0.304	0.345	0.359	0.304	0.344
269.0	0.410	0.385	0.354	0.405	0.351	0.359	0.373	0.395	0.351	0.379
283.9	0.363	0.301	0.317	0.332	0.289	0.312	0.346	0.364	0.289	0.324
299.1	0.871	0.878	0.868	0.844	0.843	0.848	0.881	0.883	0.843	0.869
322.0	0.325	0.315	0.298	0.269	0.279	0.313	0.313	0.317	0.269	0.313
339.0	0.311	0.336	0.338	0.295	0.307	0.332	0.322	0.354	0.295	0.327
358.0	0.381	0.376	0.399	0.329	0.354	0.442	0.373	0.369	0.329	0.375
367.0	0.397	0.400	0.397	0.408	0.423	0.393	0.427	0.410	0.393	0.404
377.5	0.579	0.559	0.556	0.535	0.630	0.571	0.669	0.598	0.535	0.575

Table 16

RSRM-21B AFT CYLINDER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	AVE.	EXPOSURE TIME
85.0	7.2	7.5	8.1	8.2	9.8	6.1	8.1	8.5	7.9	46.2
90.0	8.0	8.7	8.6	9.3	9.5	8.7	8.8	9.2	8.8	45.5
98.0	9.1	8.8	9.9	8.9	11.2	9.5	9.5	9.7	9.6	44.5
105.8	8.9	6.0	9.6	10.3	11.8	10.3	10.1	10.0	9.6	43.7
116.0	10.1	4.5	8.8	9.4	10.8	9.7	8.9	8.7	8.9	42.9
124.5	9.2	8.1	9.2	8.7	11.1	9.8	9.5	8.7	9.3	41.9
133.0	9.2	7.3	10.1	11.3	10.9	10.2	9.4	10.0	9.8	40.6
145.5	9.2	9.4	10.5	12.8	11.2	11.3	9.9	8.8	10.4	38.6
158.5	9.1	9.4	10.1	11.2	11.3	9.8	8.9	9.8	9.9	37.0
166.0	9.1	8.0	8.6	9.7	9.5	9.9	7.6	8.3	8.8	36.6
177.7	10.1	7.2	9.5	10.5	12.0	10.1	10.3	10.0	10.0	35.1
192.5	8.9	9.5	9.3	9.9	8.7	10.0	9.5	9.2	9.3	31.9
202.5	9.1	7.2	8.8	9.8	9.5	9.1	8.2	7.9	8.7	30.4
214.0	8.7	9.7	8.7	10.3	10.1	10.3	9.3	8.7	9.5	28.6
227.3	8.5	8.6	9.3	9.2	11.5	12.0	10.5	9.8	9.9	26.5
238.3	7.3	8.9	8.4	10.5	10.0	8.1	8.1	7.6	8.6	24.9
250.0	8.7	9.1	8.6	10.1	10.1	10.6	8.8	8.4	9.3	23.3
269.0	8.0	10.0	10.1	7.4	10.4	10.3	9.9	8.7	9.3	20.2
283.9	9.0	11.1	10.7	9.0	11.8	9.3	8.7	7.1	9.6	17.4
299.1	8.2	11.4	9.1	11.4	12.9	13.3	9.1	7.7	10.4	18.0
322.0	6.9	7.7	8.9	11.2	10.2	8.0	7.6	8.0	8.6	13.1
339.0	8.3	6.7	6.1	9.4	8.6	7.4	7.1	5.5	7.4	12.5
358.0	3.8	4.5	1.5	7.9	5.0	0	4.1	4.0	3.8	11.6
367.0	6.3	8.0	8.4	7.3	6.3	6.9	4.1	5.2	6.6	11.2
377.5	4.2	6.8	6.5	5.4	6.4	7.1	5.1	4.5	5.7	20.8

MOTOR ACTION TIME = 125.8 SECONDS

Table 16
RSRM-21B AFT CYLINDER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MEDIAN	MAX.	DESIGN M+3S
85.0	0.334	0.346	0.373	0.381	0.455	0.281	0.373	0.392	0.373	0.455	0.618
90.0	0.362	0.395	0.390	0.425	0.433	0.397	0.402	0.417	0.400	0.433	0.576
98.0	0.404	0.392	0.442	0.398	0.498	0.423	0.423	0.432	0.423	0.498	0.582
105.8	0.391	0.264	0.420	0.448	0.517	0.451	0.440	0.436	0.438	0.517	0.559
116.0	0.433	0.193	0.376	0.405	0.464	0.418	0.382	0.372	0.394	0.464	0.527
124.5	0.384	0.341	0.384	0.365	0.463	0.411	0.397	0.364	0.384	0.463	0.522
133.0	0.375	0.295	0.412	0.458	0.443	0.415	0.382	0.404	0.408	0.458	0.516
145.5	0.355	0.363	0.407	0.496	0.432	0.438	0.383	0.339	0.395	0.496	0.493
158.5	0.337	0.347	0.373	0.415	0.417	0.362	0.330	0.364	0.363	0.417	0.491
166.0	0.333	0.292	0.313	0.354	0.346	0.362	0.279	0.303	0.323	0.362	0.466
177.7	0.354	0.253	0.333	0.368	0.420	0.356	0.360	0.350	0.355	0.420	0.452
192.5	0.284	0.302	0.298	0.317	0.265	0.318	0.303	0.294	0.300	0.318	0.400
202.5	0.278	0.220	0.268	0.298	0.289	0.278	0.249	0.240	0.273	0.298	0.376
214.0	0.249	0.278	0.248	0.294	0.288	0.294	0.267	0.250	0.273	0.294	0.351
227.3	0.225	0.229	0.246	0.245	0.306	0.318	0.279	0.260	0.253	0.318	0.317
238.3	0.182	0.222	0.210	0.261	0.248	0.202	0.202	0.190	0.206	0.261	0.331
250.0	0.202	0.213	0.201	0.236	0.235	0.246	0.205	0.196	0.209	0.246	0.285
269.0	0.161	0.203	0.204	0.149	0.210	0.209	0.199	0.175	0.201	0.210	0.297
283.9	0.157	0.193	0.186	0.157	0.206	0.161	0.151	0.123	0.159	0.206	0.251
299.1	0.148	0.205	0.164	0.205	0.232	0.240	0.163	0.139	0.184	0.240	0.253
322.0	0.090	0.101	0.117	0.147	0.133	0.105	0.100	0.105	0.105	0.147	0.197
339.0	0.104	0.084	0.076	0.118	0.108	0.092	0.089	0.069	0.091	0.118	0.190
358.0	0.044	0.052	0.017	0.092	0.058	0	0.047	0.046	0.046	0.092	0.181
367.0	0.071	0.090	0.094	0.082	0.071	0.077	0.046	0.058	0.074	0.094	0.175
377.5	0.087	0.141	0.136	0.112	0.133	0.148	0.106	0.093	0.123	0.148	0.237

Table 16

RSRM-21B AFT CYLINDER INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	MIN.	PLANE	REQUIRED S.F.
85.0	3.49	3.76	3.49	3.41	2.86	4.63	3.49	3.32	2.86	180.0	1.5
90.0	3.49	3.20	3.24	2.98	2.92	3.19	3.15	3.03	2.92	180.0	1.5
98.0	2.81	2.90	2.57	2.85	2.28	2.68	2.68	2.63	2.28	180.0	1.5
105.8	2.78	4.09	2.57	2.41	2.09	2.39	2.45	2.48	2.09	180.0	1.5
116.0	2.42	5.44	2.79	2.59	2.26	2.51	2.75	2.82	2.26	180.0	1.5
124.5	2.68	3.02	2.68	2.82	2.22	2.51	2.59	2.83	2.22	180.0	1.5
133.0	2.61	3.32	2.38	2.14	2.21	2.36	2.57	2.43	2.14	136.8	1.5
145.5	2.62	2.56	2.29	1.88	2.15	2.12	2.43	2.74	1.88	136.8	1.5
158.5	2.61	2.54	2.36	2.12	2.11	2.43	2.67	2.42	2.11	180.0	1.5
166.0	2.55	2.91	2.72	2.40	2.46	2.35	3.05	2.81	2.35	226.8	1.5
177.7	2.82	3.95	3.00	2.72	2.38	2.81	2.78	2.86	2.38	180.0	2.0
192.5	2.75	2.58	2.62	2.46	2.94	2.45	2.57	2.65	2.45	226.8	1.5
202.5	2.63	3.32	2.72	2.45	2.53	2.63	2.93	3.04	2.45	136.8	1.5
214.0	2.81	2.52	2.82	2.38	2.43	2.38	2.62	2.80	2.38	136.8	1.5
227.3	2.89	2.84	2.64	2.65	2.12	2.04	2.33	2.50	2.04	226.8	1.5
238.3	3.46	2.84	3.00	2.41	2.54	3.12	3.12	3.32	2.41	136.8	1.5
250.0	2.72	2.58	2.74	2.33	2.34	2.24	2.68	2.81	2.24	226.8	1.5
269.0	3.11	2.46	2.45	3.36	2.38	2.39	2.51	2.86	2.38	180.0	1.5
283.9	2.87	2.33	2.42	2.87	2.18	2.80	2.98	3.66	2.18	180.0	1.5
299.1	4.57	3.30	4.12	3.30	2.91	2.82	4.15	4.86	2.82	226.8	2.0
322.0	4.22	3.76	3.25	2.59	2.86	3.62	3.80	3.62	2.59	136.8	1.5
339.0	3.65	4.52	5.00	3.22	3.52	4.13	4.27	5.51	3.22	136.8	1.5
358.0	8.64	7.31	22.35	4.13	6.55	+	8.09	8.26	4.13	136.8	1.5
367.0	5.35	4.22	4.04	4.63	5.35	4.94	8.26	6.55	4.04	90.0	1.5
377.5	6.09	3.76	3.90	4.73	3.98	3.58	5.00	5.70	3.58	226.8	1.5

SEGMENT MINIMUM = 1.88 AT THE 145.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	0.0	46.8	90.0	136.8	180.0	226.8	270.0	316.8	DEGREE LOCATIONS MIN.	PLANE	REQUIRED S.F.
85.0	4.54	4.34	4.10	3.97	3.47	5.43	4.03	3.91	3.47	180.0	1.5
90.0	3.92	3.59	3.67	3.36	3.32	3.54	3.49	3.47	3.32	180.0	1.5
98.0	3.34	3.51	3.09	3.41	2.81	3.16	3.18	3.18	2.81	180.0	1.5
105.8	2.81	4.34	2.64	2.50	2.20	2.41	2.45	2.52	2.20	180.0	1.5
116.0	2.60	5.53	2.92	2.67	2.35	2.54	2.75	2.85	2.35	180.0	1.5
124.5	2.80	3.06	2.84	2.84	2.31	2.55	2.62	2.88	2.31	180.0	1.5
133.0	3.03	3.89	2.79	2.51	2.58	2.66	2.88	2.83	2.51	136.8	1.5
145.5	2.57	2.56	2.27	1.90	2.19	2.12	2.37	2.67	1.90	136.8	1.5
158.5	2.66	2.62	2.44	2.18	2.21	2.43	2.67	2.43	2.18	136.8	1.5
166.0	2.91	3.35	3.10	2.73	2.82	2.61	3.51	3.10	2.61	226.8	1.5
177.7	4.13	5.85	4.44	4.08	3.56	4.14	4.11	4.25	3.56	180.0	2.0
192.5	3.27	3.11	3.12	2.91	3.32	2.96	3.02	3.16	2.91	136.8	1.5
202.5	2.66	3.32	2.76	2.47	2.55	2.63	2.90	3.04	2.47	136.8	1.5
214.0	2.82	2.53	2.84	2.38	2.43	2.38	2.64	2.80	2.38	136.8	1.5
227.3	3.43	3.44	3.07	2.90	2.43	2.41	2.78	3.01	2.41	226.8	1.5
238.3	3.47	2.84	3.00	2.41	2.60	3.05	3.13	3.32	2.41	136.8	1.5
250.0	2.78	2.61	2.76	2.36	2.35	2.24	2.68	2.83	2.24	226.8	1.5
269.0	3.55	2.90	2.74	3.72	2.67	2.72	2.87	3.26	2.67	180.0	1.5
283.9	3.31	2.56	2.70	3.11	2.40	2.94	3.29	3.96	2.40	180.0	1.5
299.1	6.89	5.28	6.29	5.12	4.63	4.53	6.40	7.35	4.53	226.8	2.0
322.0	4.61	4.12	3.55	2.83	3.10	3.98	4.13	4.02	2.83	136.8	1.5
339.0	3.99	5.00	5.45	3.50	3.84	4.61	4.62	6.13	3.50	136.8	1.5
358.0	9.66	8.23	24.47	4.58	7.10	+	8.94	9.02	4.58	136.8	1.5
367.0	6.59	5.44	5.22	5.98	6.96	6.10	10.28	8.07	5.22	90.0	1.5
377.5	7.66	4.96	6.09	5.78	5.74	4.86	7.31	7.43	4.86	226.8	1.5

SEGMENT MINIMUM = 1.90 AT THE 145.5 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 17
RSRM-21B AFT CENTER SEGME[illegible] [illegible]SULATION PERFORMANCE

PART NO. 1U76667-02 PREFIRE MEASUREMENTS
SERIAL NO. 0000031 INCHES

STATION (IN)	0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
	DEGREE LOCATIONS										
3.5	2.642	2.595	2.691	2.672	2.648	2.656	2.676	2.723	2.595	2.664	2.120
11.0	2.434	2.685	2.544	2.620	2.607	2.779	2.632	2.677	2.4[illegible]4	2.626	1.900
30.7	1.177	0.837	0.914	0.937	0.912	0.902	0.871	0.922	0.837	0.913	0.774
36.2	0.797	0.822	0.833	0.853	0.829	0.804	0.805	0.827	0.797	0.825	0.600
44.6	0.361	0.361	0.364	0.362	0.370	0.361	0.362	0.361	0.361	0.361	0.360
71.5	0.186	0.185	0.179	0.180	0.187	0.179	0.182	0.180	0.179	0.181	0.170
126.0	0.151	0.154	0.151	0.147	0.147	0.151	0.151	0.154	0.147	0.151	0.150
145.0	0.160	0.155	0.152	0.153	0.159	0.153	0.157	0.152	0.152	0.154	0.150
161.4	0.528	0.604	0.532	0.517	0.600	0.607	0.606	0.618	0.517	0.602	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.185	0.182	0.175	0.185	0.181	0.183	0.180	0.182	0.175	0.182	0.130
214.1	0.131	0.127	0.127	0.127	0.131	0.126	0.130	0.129	0.126	0.128	0.130
280.0	0.099	0.093	0.099	0.097	0.097	0.096	0.098	0.096	0.093	0.097	0.090
298.0	0.098	0.097	0.097	0.098	0.097	0.097	0.093	0.097	0.093	0.097	0.090
311.8	0.102	0.097	0.101	0.106	0.098	0.103	0.101	0.100	0.097	0.101	0.090

PART NO. 1U76791-01 POSTFIRE MEASUREMENTS
SERIAL NO. 0000014 INCHES

STATION (IN)	0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
	DEGREE LOCATIONS									
3.5	2.207	2.071	2.183	2.183	2.169	2.197	2.262	2.296	2.071	2.190
11.0	2.002	1.990	1.871	1.805	1.914	1.887	1.865	1.865	1.805	1.879
30.7	0.568	0.620	0.596	0.610	0.630	0.588	0.602	0.550	0.550	0.599
36.2	0.627	0.604	0.618	0.581	0.635	0.618	0.622	0.599	0.581	0.618
44.6	0.313	0.308	0.312	0.278	0.322	0.322	0.307	0.302	0.278	0.310
71.5	0.150	0.136	0.143	0.130	0.146	0.134	0.138	0.122	0.122	0.137
126.0	0.110	0.119	0.121	0.089	0.106	0.134	0.122	0.116	0.089	0.117
145.0	0.131	0.118	0.128	0.120	0.123	0.124	0.121	0.114	0.114	0.122
161.4	0.486	0.511	0.489	0.493	0.491	0.495	0.480	0.532	0.480	0.492
163.0	0.460	0.451	0.460	0.446	0.457	0.475	0.470	0.486	0.446	0.460
178.0	0.157	0.159	0.150	0.149	0.158	0.158	0.157	0.162	0.149	0.158
214.1	0.117	0.100	L	0.090	0.126	0.119	0.103	L	0.090	0.118
280.0	L	L	L	L	L	L	L	L	L	0.097
298.0	L	L	L	L	L	L	L	L	L	0.097
311.8	L	L	L	L	L	L	L	L	L	0.101

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 17

RSRM-21B AFT CENTER SEGMEN ..SULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.435	0.524	0.508	0.489	0.479	0.459	0.414	0.427	0.469	0.524	1.067
11.0	0.432	0.695	0.673	0.815	0.693	0.892<	0.767	0.812	0.731	0.892	0.829
30.7	0.609<	0.217	0.318	0.327	0.282	0.314	0.269	0.372	0.316	0.609	0.484
36.2	0.170	0.218	0.215	0.272	0.194	0.186	0.183	0.228	0.205	0.272	0.318
44.6	0.048	0.053	0.052	0.084	0.048	0.039	0.055	0.059	0.052	0.084	0.090
71.5	0.036	0.049	0.036	0.050	0.041	0.045	0.044	0.058	0.045	0.058	0.086
126.0	0.041	0.035	0.030	0.058	0.041	0.017	0.029	0.038	0.036	0.058	0.074
145.0	0.029	0.037	0.024	0.033	0.036	0.029	0.036	0.038	0.034	0.038	0.063
161.4	0.042	0.093<	0.043	0.024	0.109<	0.112<	0.126<	0.086<	0.089	0.126	0.082
163.0	0.090<	0.099<	0.090<	0.104<	0.093<	0.075	0.080	0.064	0.090	0.104	0.082
178.0	0.028	0.023	0.025	0.036	0.023	0.025	0.023	0.020	0.024	0.036	0.065
214.1	0.014	0.027	0	0.037<	0.005	0.007	0.027	0	0.010	0.037	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	3.8	4.6	4.4	4.3	4.2	4.0	3.6	3.7	4.1	114.4
11.0	4.3	7.0	6.8	8.2	7.0	9.0	7.7	8.2	7.3	99.5
30.7	12.5	4.5	6.5	6.7	5.8	6.5	5.5	7.7	7.0	48.6
36.2	5.1	6.5	6.5	8.2	5.8	5.6	5.5	6.8	6.3	33.3
44.6	3.9	4.3	4.2	6.8	3.9	3.2	4.5	4.8	4.5	12.3
71.5	3.5	4.7	3.5	4.8	3.9	4.3	4.2	5.6	4.3	10.4
126.0	4.6	3.9	3.3	6.4	4.6	1.9	3.2	4.2	4.0	9.0
145.0	3.8	4.9	3.2	4.3	4.7	3.8	4.7	5.0	4.3	7.6
161.4	4.1	9.1	4.2	2.4	10.7	11.0	12.4	8.4	7.8	10.2
163.0	8.8	9.7	8.8	10.2	9.1	7.4	7.8	6.3	8.5	10.2
178.0	4.6	3.8	4.1	5.9	3.8	4.1	3.8	3.3	4.2	6.1
214.1	2.3	4.4	0	6.1	0.8	1.1	4.4	0	2.4	6.1
280.0	0	0	0	0	0	0	0	0	0	3.5
298.0	0	0	0	0	0	0	0	0	0	2.9
311.8	0	0	0	0	0	0	0	0	0	2.0

MOTOR ACTION TIME = 125.8 SECONDS

Table 17

RSRM-218 AFT CENTER SEGMEN( )SULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	4.87	4.05	4.17	4.34	4.43	4.62	5.12	4.96	4.05	46.0	2.0
11.0	4.40	2.73	2.82	2.33	2.74	2.13	2.48	2.34	2.13	226.0	1.5
30.7	1.27<	3.57	2.43	2.37	2.74	2.46	2.88	2.08	1.27	0.0	1.5
36.2	3.53	2.75	2.79	2.21	3.09	3.23	3.28	2.63	2.21	136.0	1.5
44.6	7.50	6.79	6.92	4.29	7.50	9.23	6.55	6.10	4.29	136.0	1.5
71.5	4.72	3.47	4.72	3.40	4.15	3.78	3.86	2.93	2.93	316.0	1.5
126.0	3.66	4.29	5.00	2.59	3.66	8.82	5.17	3.95	2.59	136.0	1.5
145.0	5.17	4.05	6.25	4.55	4.17	5.17	4.17	3.95	3.95	316.0	1.5
161.4	5.62	2.54	5.49	9.83	2.17	2.11	1.87<	2.74	1.87	270.0	2.0
163.0	2.62	2.38	2.62	2.27	2.54	3.15	2.95	3.69	2.27	136.0	1.5
178.0	4.64	5.65	5.20	3.61	5.65	5.20	5.65	6.50	3.61	136.0	1.5
214.1	9.29	4.81	+	3.51	26.00	18.57	4.81	+	3.51	136.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 1.27 AT THE 30.7 INCH STATION
A " < " INDICATES THE PRECEDING SAFETY FACTOR HAS VIOLATED THE MINIMUM SAFETY FACTOR REQUIREMENT
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	6.07	4.95	5.30	5.46	5.53	5.79	6.46	6.38	4.95	46.0	2.0
11.0	5.63	3.86	3.78	3.21	3.76	3.12	3.43	3.30	3.12	226.0	1.5
30.7	1.93	3.86	2.87	2.87	3.23	2.87	3.24	2.48	1.93	0.0	1.5
36.2	4.69	3.77	3.87	3.14	4.27	4.32	4.40	3.63	3.14	136.0	1.5
44.6	7.52	6.81	7.00	4.31	7.71	9.26	6.58	6.12	4.31	136.0	1.5
71.5	5.17	3.78	4.97	3.60	4.56	3.98	4.14	3.10	3.10	316.0	1.5
126.0	3.68	4.40	5.03	2.53	3.59	8.88	5.21	4.05	2.53	136.0	1.5
145.0	5.52	4.19	6.33	4.64	4.42	5.28	4.36	4.00	4.00	316.0	1.5
161.4	12.57	6.49	12.37	21.54	5.50	5.42	4.81	7.19	4.81	270.0	2.0
163.0	6.11	5.56	6.11	5.29	5.91	7.33	6.87	8.59	5.29	136.0	1.5
178.0	6.61	7.91	7.00	5.14	7.87	7.32	7.83	9.10	5.14	136.0	1.5
214.1	9.36	4.78	+	3.43	26.20	18.00	4.81	+	3.43	136.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 1.93 AT THE 30.7 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 18

RSRM-21B FORWARD CENTER SEGMENT INSULATION PERFORMANCE

PART NO. 1U76667-02 PREFIRE MEASUREMENTS
SERIAL NO. 0000032 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN	MDT
3.5	2.739	2.732	2.641	2.673	2.713	2.688	2.706	2.754	2.641	2.710	2.120
11.0	2.278	2.263	2.328	2.363	2.283	2.286	2.331	2.145	2.145	2.285	1.900
30.7	0.837	0.828	0.859	0.858	0.863	0.855	0.891	0.889	0.828	0.859	0.774
36.2	0.781	0.837	0.865	0.805	0.831	0.823	0.853	0.834	0.781	0.832	0.600
44.6	0.360	0.356	0.385	0.358	0.365	0.358	0.361	0.361	0.356	0.361	0.360
71.5	0.187	0.185	0.184	0.183	0.185	0.181	0.183	0.185	0.181	0.185	0.170
126.0	0.156	0.155	0.154	0.151	0.153	0.150	0.151	0.155	0.150	0.154	0.150
145.0	0.152	0.152	0.150	0.152	0.150	0.151	0.154	0.155	0.150	0.152	0.150
161.4	0.585	0.580	0.603	0.597	0.623	0.629	0.612	0.614	0.580	0.608	0.236
163.0	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.550	0.236
178.0	0.180	0.181	0.175	0.183	0.179	0.185	0.184	0.184	0.175	0.182	0.130
214.1	0.133	0.133	0.134	0.133	0.132	0.131	0.131	0.135	0.131	0.133	0.130
280.0	0.100	0.098	0.102	0.098	0.098	0.101	0.099	0.101	0.098	0.100	0.090
298.0	0.097	0.099	0.100	0.101	0.098	0.102	0.102	0.101	0.097	0.101	0.090
311.8	0.097	0.098	0.101	0.101	0.102	0.099	0.106	0.098	0.097	0.100	0.090

PART NO. 1U76791-01 POSTFIRE MEASUREMENTS
SERIAL NO. 0000012 INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	MEDIAN
3.5	2.600	2.536	2.457	2.520	2.540	2.524	2.527	2.577	2.457	2.532
11.0	2.164	2.207	2.358	2.392	2.368	2.327	2.317	2.276	2.164	2.322
30.7	0.724	0.714	0.717	0.729	0.719	0.749	0.740	0.726	0.714	0.725
36.2	0.812	0.737	0.726	0.731	0.727	0.695	0.752	0.708	0.695	0.729
44.6	0.449	0.337	0.362	0.343	0.353	0.342	0.347	0.350	0.337	0.349
71.5	0.176	0.168	0.165	0.170	0.182	0.163	0.172	0.173	0.163	0.171
126.0	0.149	0.152	0.145	0.144	0.146	0.143	0.134	0.153	0.134	0.146
145.0	0.163	0.139	0.135	0.138	0.142	0.137	0.151	0.158	0.135	0.141
161.4	0.477	0.477	0.541	0.511	0.519	0.512	0.513	0.537	0.477	0.513
163.0	0.472	0.461	0.474	0.469	0.478	0.472	0.470	0.488	0.461	0.472
178.0	L	0.175	L	0.176	0.178	0.174	0.179	L	0.174	0.177
214.1	L	0.125	L	0.122	L	0.131	L	L	0.122	0.132
280.0	L	L	L	L	L	L	L	L	L	0.100
298.0	L	L	L	L	L	L	L	L	L	0.101
311.8	L	L	L	L	L	L	L	L	L	0.100

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 18

RSRM-21B FORWARD CENTER SEGMENT INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.139	0.196	0.184	0.153	0.173	0.164	0.179	0.177	0.175	0.196	1.067
11.0	0.114	0.056	0	0	0	0	0.014	0	0	0.114	0.829
30.7	0.113	0.114	0.142	0.129	0.144	0.106	0.143	0.163	0.136	0.163	0.484
36.2	0	0.100	0.139	0.074	0.104	0.128	0.101	0.126	0.102	0.139	0.318
44.6	0	0.019	0.023	0.015	0.012	0.016	0.014	0.011	0.015	0.023	0.090
71.5	0.011	0.017	0.019	0.013	0.003	0.010	0.011	0.012	0.013	0.019	0.086
126.0	0.007	0.003	0.009	0.007	0.007	0.007	0.017	0.002	0.007	0.017	0.074
145.0	0	0.013	0.015	0.014	0.008	0.014	0.003	0	0.010	0.015	0.063
161.4	0.108	<0.103	<0.062	0.086	<0.104	<0.117	<0.099	<0.077	0.101	0.117	0.082
163.0	0.078	0.089	<0.076	0.081	0.072	0.078	0.080	0.062	0.078	0.089	0.082
178.0	0	0.006	0	0.007	0.001	0.011	0.005	0	0.003	0.011	0.065
214.1	0	0.008	0	0.011	0	0	0	0	0	0.011	0.029
280.0	0	0	0	0	0	0	0	0	0	0	0.005
298.0	0	0	0	0	0	0	0	0	0	0	0.005
311.8	0	0	0	0	0	0	0	0	0	0	0.003

A " < " INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	AVE.	EXPOSURE TIME
3.5	1.2	1.7	1.6	1.3	1.5	1.4	1.6	1.5	1.5	114.4
11.0	1.1	0.6	0	0	0	0	0.1	0	0.2	99.7
30.7	2.3	2.3	2.9	2.6	2.9	2.2	2.9	3.3	2.7	49.0
36.2	0	2.9	4.1	2.2	3.1	3.8	3.0	3.7	2.8	33.9
44.6	0	1.5	1.8	1.1	0.9	1.2	1.1	0.8	1.0	13.1
71.5	1.0	1.5	1.7	1.2	0.3	1.6	1.0	1.1	1.2	11.2
126.0	0.7	0.3	0.9	0.7	0.7	0.7	1.7	0.2	0.8	9.8
145.0	0	1.6	1.8	1.7	1.0	1.7	0.4	0	1.0	8.2
161.4	9.8	9.4	5.6	7.8	9.5	10.6	9.0	7.0	8.6	11.0
163.0	7.1	8.1	6.9	7.4	6.5	7.1	7.3	5.6	7.0	11.0
178.0	0	0.8	0	0.9	0.1	1.5	0.7	0	0.5	7.4
214.1	0	1.1	0	1.5	0	0	0	0	0.3	7.4
280.0	0	0	0	0	0	0	0	0	0	4.3
298.0	0	0	0	0	0	0	0	0	0	4.1
311.8	0	0	0	0	0	0	0	0	0	3.5

MOTOR ACTION TIME = 125.8 SECONDS

Table 18

RSRM-21B FORWARD CENTER SEGMENT INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	15.25	10.82	11.52	13.86	12.25	12.93	11.84	11.98	10.82	46.0	2.0
11.0	16.67	33.93	+	+	+	+	+	+	16.67	0.0	1.5
30.7	6.85	6.79	5.45	6.00	5.30	7.30	5.41	4.75	4.75	316.0	1.5
36.2	+	6.00	4.32	8.11	5.77	4.69	5.94	4.76	4.32	90.0	1.5
44.6	+	18.95	15.65	24.00	30.00	22.50	25.71	32.73	15.65	90.0	1.5
71.5	18.45	10.00	8.95	13.00	56.67	9.44	18.45	14.17	8.95	90.0	1.5
126.0	21.43	50.00	16.67	21.43	21.43	21.43	8.82	75.00	8.82	270.0	1.5
145.0	+	11.54	10.00	10.71	18.75	10.71	50.00	+	10.00	90.0	1.5
161.4	2.19	2.29	3.81	2.74	2.27	2.02	2.38	3.06	2.02	226.0	2.0
163.0	3.03	2.65	3.11	2.91	3.28	3.03	2.95	3.81	2.65	46.0	1.5
178.0	+	21.67	+	18.57	+	11.82	26.00	+	11.82	226.0	1.5
214.1	+	16.25	+	11.82	+	+	+	+	11.82	136.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 2.02 AT THE 161.4 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 0.0	46.0	90.0	136.0	180.0	226.0	270.0	316.0	MIN.	PLANE	REQUIRED S.F.
3.5	19.71	13.94	14.35	17.47	15.68	16.39	15.12	15.56	13.94	46.0	2.0
11.0	19.98	48.41	+	+	+	+	+	+	19.98	0.0	1.5
30.7	7.41	7.26	6.05	6.65	5.99	8.07	6.23	5.45	5.45	316.0	1.5
36.2	+	8.37	6.22	10.88	7.99	6.43	8.45	6.62	6.22	90.0	1.5
44.6	+	18.74	16.74	23.87	30.42	22.37	25.79	32.82	16.74	90.0	1.5
71.5	17.00	10.88	9.68	14.08	61.67	10.06	16.64	15.42	9.68	90.0	1.5
126.0	22.29	51.67	17.11	21.57	21.86	21.43	8.88	77.50	8.88	270.0	1.5
145.0	+	11.69	10.00	10.86	18.75	10.79	51.33	+	10.00	90.0	1.5
161.4	5.42	5.63	9.73	6.94	5.99	5.38	6.18	7.97	5.38	226.0	2.0
163.0	7.05	6.18	7.24	6.79	7.64	7.05	6.87	8.87	6.18	46.0	1.5
178.0	+	30.17	+	26.14	+	16.82	36.80	+	16.82	226.0	1.5
214.1	+	16.62	+	12.09	+	+	+	+	12.09	136.0	1.5
280.0	+	+	+	+	+	+	+	+	+	0.0	1.5
298.0	+	+	+	+	+	+	+	+	+	0.0	1.5
311.8	+	+	+	+	+	+	+	+	+	0.0	1.5

SEGMENT MINIMUM = 5.38 AT THE 161.4 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

Table 19

RSRM-21B FORWARD SEGMENT STAR TIP INSULATION PERFORMANCE

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76666-02
SERIAL NO. 0000017

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN	MDT
3.5	2.529	2.531	2.567	2.603	2.586	2.529	2.567	2.120
13.0	0.894	0.878	0.878	0.887	0.940	0.878	0.887	0.650
27.0	0.581	0.576	0.620	0.559	0.573	0.559	0.576	0.450
44.0	0.293	0.292	0.292	0.289	0.292	0.289	0.292	0.250
60.0	0.116	0.117	0.123	0.128	0.135	0.116	0.123	0.100
94.7	0.102	0.101	0.096	0.096	0.094	0.094	0.096	0.090
142.0	0.156	0.149	0.149	0.146	0.151	0.146	0.149	0.113
152.0	0.379	0.370	0.346	0.346	0.367	0.346	0.367	0.317
162.0	0.758	0.787	0.728	0.755	0.740	0.728	0.755	0.547
175.5	0.723	0.765	0.724	0.583	0.697	0.583	0.723	0.604
187.0	0.663	0.691	0.672	0.638	0.654	0.638	0.663	0.640
199.0	0.754	0.727	0.763	0.732	0.785	0.727	0.754	0.683
213.0	0.763	0.753	0.785	0.719	0.733	0.719	0.753	0.677
224.0	0.768	0.777	0.791	0.784	0.795	0.768	0.784	0.677
230.0	0.731	0.736	0.802	0.749	0.740	0.731	0.740	0.677
236.0	0.655	0.655	0.676	0.662	0.658	0.655	6.658	0.578
240.0	0.639	0.652	0.679	0.652	0.651	0.639	0.652	0.574
254.0	0.583	0.594	0.605	0.594	0.587	0.583	0.594	0.568
263.0	0.605	0.591	0.587	0.584	0.599	0.584	0.591	0.568
282.0	0.663	0.662	0.648	0.634	0.642	0.634	0.648	0.568
293.0	0.606	0.630	0.607	0.622	0.636	0.606	0.622	0.546
305.0	0.619	0.635	0.665	0.648	0.674	0.619	0.648	0.525
312.0	0.666	0.681	0.753	0.732	0.678	0.666	0.681	0.541
321.0	1.044	1.082	1.072	1.056	1.070	1.044	1.070	0.918
339.0	0.589	0.578	0.585	0.596	0.601	0.578	0.589	0.551
350.0	0.575	0.610	0.616	0.586	0.580	0.575	0.586	0.523
362.0	0.575	0.566	0.604	0.586	0.608	0.566	0.586	0.520
371.0	0.584	0.598	0.614	0.585	0.640	0.584	0.598	0.520
383.0	0.587	0.582	0.598	0.581	0.625	0.581	0.587	0.511
397.0	0.565	0.565	0.610	0.591	0.612	0.565	0.591	0.503
403.0	1.117	1.118	1.117	1.118	1.134	1.117	1.118	0.950

POSTFIRE MEASUREMENTS
INCHES

PART NO. 1U76790-05
SERIAL NO. 0000007

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	MEDIAN
3.5	2.488	2.508	2.546	2.550	2.507	2.488	2.508
13.0	0.845	0.857	0.850	0.846	0.859	0.845	0.857
27.0	L	L	L	L	L	L	0.576
44.0	L	L	L	L	L	L	0.292
60.0	L	L	L	L	L	L	0.123
94.7	L	L	L	L	L	L	0.096
142.0	L	L	L	L	L	L	0.149
152.0	0.307	0.322	0.312	0.328	0.314	0.307	0.314
162.0	0.634	0.631	0.625	0.617	0.631	0.617	0.631
175.5	0.541	0.508	0.535	0.505	0.518	0.505	0.518
187.0	0.435	0.391	0.425	0.418	0.505	0.391	0.425
199.0	0.514	0.533	0.512	0.544	0.498	6.498	0.514
213.0	0.513	0.499	0.525	0.472	0.507	0.472	0.507
224.0	0.560	0.537	0.562	0.552	0.498	0.498	0.552
230.0	0.519	0.505	0.509	0.504	0.500	0.500	0.505
236.0	0.433	0.429	0.450	0.459	0.440	0.429	0.440
240.0	0.420	0.438	0.439	0.418	0.447	0.418	0.438
254.0	0.428	0.439	0.440	0.463	0.415	0.415	0.439
263.0	0.397	0.373	0.389	0.395	0.381	0.373	0.389
282.0	0.429	0.433	0.451	0.397	0.399	0.397	0.429
293.0	0.459	0.458	0.418	0.416	0.394	0.394	0.418
305.0	0.454	0.451	0.459	0.442	0.491	0.442	0.454
312.0	0.534	0.507	0.530	0.468	0.498	0.468	0.507
321.0	0.819	0.775	0.839	0.765	0.775	0.765	0.775
339.0	0.470	0.395	0.382	0.410	0.395	0.382	0.395
350.0	0.427	0.430	0.427	0.365	0.404	0.365	0.427
362.0	0.406	0.427	0.416	0.424	0.428	0.406	0.424
371.0	0.435	0.445	0.465	0.431	0.425	0.425	0.435
383.0	0.408	0.439	0.419	0.393	0.420	0.393	0.419
397.0	0.414	0.445	0.416	0.433	0.420	0.414	0.420
403.0	0.882	0.920	0.891	0.863	0.895	0.863	0.891

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 19

RSRM-21B FORWARD SEGMENT STAR TIP INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MLD)
INCHES

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.041	0.023	0.021	0.053	0.079	0.041	0.079	0.103
13.0	0.049	0.021	0.020	0.041	0.081	0.041	0.081	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
60.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.072	0.048	0.034	0.018	0.053	0.048	0.072	0.123
162.0	0.124	0.126	0.103	0.138	0.109	0.124	0.138	0.227
175.5	0.182	0.257	0.109	0.078	0.179	0.182	0.257	0.324
187.0	0.228	0.300	0.247	0.220	0.149	0.228	0.300	0.398
199.0	0.240	0.194	0.251	0.188	0.287	0.240	0.287	0.427
213.0	0.250	0.254	0.260	0.247	0.226	0.250	0.260	0.423
224.0	0.200	0.240	0.229	0.232	0.297	0.232	0.297	0.422
230.0	0.212	0.231	0.293	0.245	0.240	0.240	0.293	0.375
236.0	0.222	0.2[illegible]6	0.226	0.203	0.218	0.222	0.226	0.327
240.0	0.219	0.214	0.240	0.234	0.204	0.219	0.240	0.342
254.0	0.155	0.155	0.165	0.131	0.172	0.155	0.172	0.318
263.0	0.208	0.218	0.198	0.189	0.218	0.208	0.218	0.334
282.0	0.234	0.229	0.197	0.237	0.243	0.234	0.243	0.349
293.0	0.147	0.172	0.189	0.206	0.242	0.189	0.242	0.330
305.0	0.165	0.184	0.206	0.206	0.18[illegible]	0.184	0.206	0.309
312.0	0.132	0.174	0.223	0.264	0.180	0.180	0.264	0.308
321.0	0.225	0.307	0.233	0.291	0.295	0.291	0.307	0.434
339.0	0.119	0.18[illegible]	0.203	0.186	0.206	0.186	0.206	0.319
350.0	0.140	0.188	0.189	0.221	0.176	0.188	0.221	0.300
362.0	0.169	0.139	0.188	0.162	0.188	0.169	0.188	0.285
371.0	0.149	0.153	0.149	0.154	0.215	0.153	0.215	0.304
383.0	0.179	0.143	0.179	0.188	0.205	0.179	0.205	0.295
397.0	0.151	0.120	0.194	0.158	0.192	0.158	0.194	0.287
403.0	0.235	0.198	0.226	0.255	0.239	0.235	0.255	0.287

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	AVE.	EXPOSURE TIME
3.5	1.2	0.7	0.6	1.5	2.3	1.2	35.1
13.0	2.5	1.1	1.0	2.1	4.1	2.1	19.8
27.0	0	0	0	0	0	0	4.9
44.0	0	0	0	0	0	0	3.1
60.0	0	0	0	0	0	0	1.6
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	2.2	1.4	1.0	0.5	1.6	1.4	33.3
162.0	2.1	2.1	1.7	2.3	1.8	2.0	59.2
175.5	2.0	2.8	2.1	0.9	2.0	1.9	91.1
187.0	2.2	2.9	2.4	2.1	1.4	2.2	104.2
199.0	2.3	1.9	2.4	1.8	2.8	2.2	104.2
213.0	2.4	2.4	2.5	2.4	2.2	2.4	104.2
224.0	1.9	2.3	2.2	2.2	2.9	2.3	104.2
230.0	2.0	2.2	2.8	2.4	2.3	2.3	104.2
236.0	2.1	2.2	2.2	1.9	2.1	2.1	104.2
240.0	2.1	2.1	2.3	2.2	2.0	2.1	104.2
254.0	1.5	1.5	1.6	1.3	1.7	1.5	104.2
263.0	2.0	2.1	1.9	1.8	2.1	2.0	104.2
282.0	2.2	2.2	1.9	2.3	2.3	2.2	104.2
293.0	1.4	1.7	1.8	2.0	2.3	1.8	104.2
305.0	1.6	1.8	2.0	2.0	1.8	1.8	104.2
312.0	1.3	1.7	2.1	2.5	1.7	1.9	104.2
321.0	2.1	2.9	2.2	2.7	2.8	2.5	106.4
339.0	1.2	1.8	2.0	1.8	2.0	1.7	102.7
350.0	1.4	1.8	1.8	2.2	1.7	1.8	102.5
362.0	1.7	1.4	1.9	1.6	1.8	1.7	101.5
371.0	1.5	1.6	1.5	1.6	2.2	1.7	97.0
383.0	1.8	1.5	1.8	1.9	2.1	1.8	98.2
397.0	1.5	1.2	1.9	1.5	1.9	1.6	102.5
403.0	1.9	1.6	1.8	2.0	1.9	1.8	125.8

MOTOR ACTION TIME = 125.8 SECONDS

Table 19

RSRM-21B FORWARD SEGMENT STAR TIP INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE	REQUIRED S.F.
3.5	51.71	92.17	+	40.00	26.04	26.04	352.0	2.0
13.0	13.27	30.95	32.50	15.85	8.02	8.02	352.0	1.5
27.0	+	+	+	+	+	+	90.0	1.5
44.0	+	+	+	+	+	+	90.0	1.5
60.0	+	+	+	+	+	+	90.0	1.5
94.7	+	+	+	+	+	+	90.0	1.5
142.0	+	+	+	+	+	+	90.0	1.5
152.0	4.40	6.60	9.32	17.61	5.98	4.40	90.0	1.5
162.0	4.41	4.34	5.31	3.96	5.02	3.96	286.0	2.0
175.5	3.32	2.35	3.20	7.74	3.37	2.35	154.0	1.5
187.0	2.81	2.13	2.59	2.91	4.30	2.13	154.0	1.5
199.0	2.85	3.52	2.72	3.63	2.38	2.38	352.0	1.5
213.0	2.71	2.67	2.60	2.74	3.00	2.60	222.0	1.5
224.0	3.39	2.82	2.96	2.92	2.28	2.28	352.0	1.5
230.0	3.19	2.93	2.31	2.76	2.82	2.31	222.0	1.5
236.0	2.60	2.56	2.56	2.85	2.65	2.56	222.0	1.5
240.0	2.62	2.60	2.39	2.45	2.81	2.39	222.0	1.5
254.0	3.66	3.66	3.44	4.34	3.30	3.30	352.0	1.5
263.0	2.73	2.61	2.87	3.01	2.61	2.61	154.0	1.5
282.0	2.43	2.48	2.88	2.40	2.34	2.34	352.0	1.5
293.0	3.71	3.17	2.89	2.65	2.26	2.26	352.0	1.5
305.0	3.18	2.85	2.55	2.85	2.87	2.55	222.0	1.5
312.0	4.10	3.11	2.43	2.05	3.01	2.05	286.0	1.5
321.0	4.08	2.99	3.94	3.15	3.11	2.99	154.0	2.0
339.0	4.63	3.01	2.71	2.96	2.67	2.67	352.0	1.5
350.0	3.53	2.78	2.77	2.37	2.97	2.37	286.0	1.5
362.0	3.08	3.74	2.77	3.21	2.89	2.77	222.0	1.5
371.0	3.49	3.40	3.49	3.38	2.42	2.42	352.0	1.5
383.0	2.85	3.57	2.85	2.72	2.49	2.49	352.0	1.5
397.0	3.33	4.19	2.59	3.18	2.62	2.59	222.0	1.5
403.0	4.04	4.88	4.20	3.73	3.97	3.73	286.0	1.5

SEGMENT MINIMUM = 2.05 AT THE 312.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 90.0	154.0	222.0	286.0	352.0	MIN.	PLANE
3.5	61.60	+	+	49.11	32.73	32.73	352.0
13.0	18.24	41.01	43.90	21.63	11.60	11.60	352.0
27.0	+	+	+	+	+	+	90.0
44.0	+	+	+	+	+	+	90.0
60.0	+	+	+	+	+	+	90.0
94.7	+	+	+	+	+	+	90.0
142.0	+	+	+	+	+	+	90.0
152.0	5.26	7.71	10.18	19.22	6.92	5.26	90.0
162.0	6.11	6.01	7.07	5.47	6.79	5.47	286.0
175.5	3.97	2.98	3.83	7.47	3.89	2.98	154.0
187.0	2.91	2.30	2.72	2.90	4.39	2.30	154.0
199.0	3.14	3.75	3.04	3.89	2.74	2.74	352.0
213.0	3.05	2.96	3.02	2.91	3.24	2.91	286.0
224.0	3.04	3.24	3.45	3.38	2.68	2.68	352.0
230.0	3.45	3.19	2.74	3.06	3.08	2.74	222.0
236.0	2.95	2.90	2.99	3.26	3.02	2.90	154.0
240.0	2.92	3.05	2.83	2.79	3.19	2.79	286.0
254.0	3.76	3.83	3.67	4.53	3.41	3.41	352.0
263.0	2.91	2.71	2.96	3.09	2.75	2.71	154.0
282.0	2.83	2.89	3.29	2.68	2.64	2.64	352.0
293.0	4.12	3.66	3.21	3.02	2.63	2.63	352.0
305.0	3.75	3.45	3.23	3.15	3.68	3.15	286.0
312.0	5.05	3.91	3.38	2.77	3.77	2.77	286.0
321.0	4.64	3.52	4.60	3.63	3.63	3.52	154.0
339.0	4.95	3.16	2.88	3.20	2.92	2.88	222.0
350.0	3.89	3.29	3.26	2.65	3.30	2.65	286.0
362.0	3.40	4.07	3.21	3.62	3.38	3.21	222.0
371.0	3.92	3.91	4.12	3.80	2.98	2.98	352.0
383.0	3.28	4.07	3.34	3.09	3.05	3.05	352.0
397.0	3.74	4.71	3.14	3.74	3.19	3.14	222.0
403.0	4.75	5.65	4.94	4.38	4.74	4.38	286.0

SEGMENT MINIMUM = 2.30 AT THE 187.0 INCH STATION

Table 20

RSRM-21B FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

PREFIRE MEASUREMENTS
INCHES

PART NO. 1U76666-02
SERIAL NO. 0000017

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN	MDT
3.5	2.535	2.520	2.529	2.484	2.619	2.484	2.529	2.120
13.0	0.889	0.989	0.897	0.947	0.965	0.889	0.947	0.650
27.0	0.579	0.603	0.578	0.634	0.565	0.565	0.579	0.450
44.0	0.286	0.286	0.293	0.299	0.288	0.286	0.288	0.250
60.0	0.116	0.118	0.116	0.126	0.125	0.116	0.118	0.100
94.7	0.102	0.098	0.100	0.097	0.093	0.093	0.098	0.090
142.0	0.136	0.151	0.150	0.147	0.150	0.136	0.150	0.113
152.0	0.372	0.387	0.355	0.356	0.351	0.351	0.356	0.317
162.0	0.763	0.810	0.746	0.773	0.742	0.742	0.763	0.547
175.5	0.763	0.716	0.737	0.738	0.698	0.698	0.737	0.604
187.0	0.677	0.697	0.660	0.677	0.658	0.658	0.677	0.640
199.0	0.750	0.735	0.719	0.727	0.770	0.719	0.735	0.683
213.0	0.749	0.781	0.740	0.742	0.748	0.740	0.748	0.677
224.0	0.814	0.801	0.786	0.790	0.777	0.777	0.790	0.677
230.0	0.777	0.798	0.723	0.737	0.741	0.723	0.741	0.677
236.0	0.681	0.701	0.687	0.665	0.681	0.665	0.681	0.578
240.0	0.670	0.700	0.656	0.689	0.693	0.656	0.689	0.574
254.0	0.628	0.637	0.571	0.598	0.591	0.571	0.598	0.568
263.0	0.613	0.589	0.572	0.601	0.579	0.572	0.589	0.560
282.0	0.679	0.678	0.671	0.636	0.669	0.636	0.671	0.560
293.0	0.679	0.634	0.623	0.636	0.652	0.623	0.636	0.546
305.0	0.675	0.651	0.641	0.669	0.670	0.641	0.669	0.525
312.0	0.695	0.710	0.698	0.701	0.688	0.688	0.698	0.541
321.0	1.043	1.067	1.060	1.091	1.083	1.043	1.067	0.918
339.0	0.612	0.585	0.580	0.658	0.603	0.580	0.603	0.551
350.0	0.585	0.600	0.639	0.605	0.586	0.585	0.600	0.523
362.0	0.601	0.590	0.566	0.629	0.592	0.566	0.592	0.520
371.0	0.610	0.584	0.654	0.608	0.583	0.583	0.608	0.520
383.0	0.580	0.574	0.576	0.575	0.591	0.574	0.576	0.511
397.0	0.571	0.586	0.581	0.625	0.607	0.571	0.586	0.503
403.0	1.115	1.114	1.165	1.114	1.127	1.114	1.115	0.950

POSTFIRE MEASUREMENTS
INCHES

PART NO. 1U76790-05
SERIAL NO. 0000007

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	MEDIAN
3.5	2.452	2.484	2.473	2.446	2.561	2.446	2.473
13.0	0.887	0.913	0.827	0.874	0.848	0.827	0.874
27.0	L	L	L	L	L	L	0.579
44.0	L	L	L	L	L	L	0.288
60.0	L	L	L	L	L	L	0.118
94.7	L	L	L	L	L	L	0.098
142.0	L	L	L	L	L	L	0.150
152.0	0.353	0.363	L	L	L	0.353	0.355
162.0	0.671	0.684	0.709	0.680	0.666	0.666	0.680
175.5	0.538	0.588	0.599	0.576	0.564	0.538	0.576
187.0	0.509	0.518	0.493	0.500	0.502	0.493	0.502
199.0	0.613	0.590	0.628	0.596	0.588	0.588	0.596
213.0	0.585	0.603	0.603	0.626	0.575	0.575	0.603
224.0	0.640	0.672	0.648	0.686	0.635	0.635	0.648
230.0	0.561	0.650	0.623	0.604	0.576	0.561	0.604
236.0	0.567	0.533	0.504	0.535	0.526	0.504	0.533
240.0	0.558	0.540	0.527	0.500	0.522	0.500	0.527
254.0	0.485	0.544	0.470	0.466	0.461	0.461	0.470
263.0	0.484	0.443	0.446	0.459	0.462	0.443	0.459
282.0	0.536	0.516	0.535	0.515	0.517	0.515	0.517
293.0	0.580	0.496	0.495	0.502	0.493	0.493	0.496
305.0	0.520	0.503	0.545	0.516	0.543	0.503	0.520
312.0	0.574	0.573	0.567	0.567	0.562	0.562	0.567
321.0	0.862	0.965	0.870	0.852	0.847	0.847	0.862
339.0	0.475	0.529	0.578	0.463	0.528	0.463	0.528
350.0	0.425	0.457	0.447	0.473	0.447	0.425	0.447
362.0	0.431	0.441	0.441	0.460	0.478	0.431	0.441
371.0	0.444	0.425	0.450	0.472	0.489	0.425	0.450
383.0	0.461	0.441	0.453	0.445	0.426	0.426	0.445
397.0	0.418	0.406	0.438	0.427	0.442	0.406	0.427
403.0	0.919	0.910	0.893	0.893	0.925	0.893	0.910

AN " L " INDICATES THAT LINER MATERIAL WAS REMAINING AT THAT LOCATION.
THE MEDIAN AND MINIMUM VALUES WERE CALCULATED USING THE PREFIRE THICKNESSES
AT THE LOCATIONS WHERE LINER MATERIAL WAS REMAINING

Table 20

RSRM-21B FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
INCHES

STATION (IN)	DEGREES LOCATIONS 74.0	140.0	206.0	270.0	336.0	MEDIAN	MAX.	DESIGN M+3S
3.5	0.083	0.036	0.056	0.038	0.058	0.056	0.083	0.103
13.0	0.002	0.076	0.070	0.073	0.117(	0.073	0.117	0.101
27.0	0	0	0	0	0	0	0	0.044
44.0	0	0	0	0	0	0	0	0.015
60.0	0	0	0	0	0	0	0	0.012
94.7	0	0	0	0	0	0	0	0.004
142.0	0	0	0	0	0	0	0	0.019
152.0	0.019	0	0	0	0	0	0.019	0.123
162.0	0.092	0.126	0.037	0.093	0.076	0.092	0.126	0.227
175.5	0.225	0.120	0.138	0.162	0.134	0.138	0.225	0.324
187.0	0.168	0.179	0.167	0.177	0.156	0.168	0.179	0.398
199.0	0.137	0.145	0.091	0.131	0.182	0.137	0.182	0.427
213.0	0.164	0.178	0.145	0.116	0.165	0.164	0.178	0.423
224.0	0.174	0.129	0.138	0.104	0.142	0.138	0.174	0.422
230.0	0.216	0.148	0.100	0.133	0.165	0.148	0.216	0.375
236.0	0.114	0.160	0.183	0.130	0.155	0.155	0.183	0.327
240.0	0.112	0.160	0.129	0.189	0.171	0.160	0.189	0.342
254.0	0.143	0.093	0.101	0.132	0.130	0.139	0.143	0.318
263.0	0.129	0.146	0.126	0.142	0.117	0.129	0.146	0.334
282.0	0.143	0.162	0.136	0.121	0.192	0.143	0.162	0.349
293.0	0.099	0.138	0.120	0.134	0.159	0.134	0.159	0.330
305.0	0.155	0.148	0.096	0.153	0.127	0.148	0.155	0.309
312.0	0.121	0.137	0.131	0.134	0.126	0.131	0.137	0.308
321.0	0.181	0.102	0.190	0.239	0.236	0.190	0.239	0.434
339.0	0.137	0.056	0.002	0.195	0.075	0.075	0.195	0.319
350.0	0.160	0.143	0.192	0.132	0.139	0.143	0.192	0.300
362.0	0.170	0.149	0.125	0.169	0.114	0.149	0.170	0.285
371.0	0.166	0.159	0.204	0.136	0.094	0.159	0.204	0.304
383.0	0.119	0.133	0.123	0.130	0.165	0.130	0.165	0.295
397.0	0.153	0.180	0.143	0.198	0.165	0.165	0.198	0.287
403.0	0.196	0.204	0.272	0.221	0.202	0.204	0.272	0.287

MATERIAL DECOMPOSITION RATE (MDR)
MILS / SECOND

STATION (IN)	DEGREES LOCATIONS 74.0	140.0	206.0	270.0	336.0	AVE.	EXPOSURE TIME
3.5	2.4	1.0	1.6	1.1	1.7	1.5	35.1
13.0	0.1	3.8	3.5	3.7	5.9	3.4	19.8
27.0	0	0	0	0	0	0	4.9
44.0	0	0	0	0	0	0	3.1
60.0	0	0	0	0	0	0	1.4
94.7	0	0	0	0	0	0	0.8
142.0	0	0	0	0	0	0	1.0
152.0	0.9	0	0	0	0	0.2	21.2
162.0	2.0	2.8	0.8	2.1	1.7	1.9	45.3
175.5	3.2	1.8	2.0	2.3	1.9	2.3	69.8
187.0	2.5	2.6	2.5	2.6	2.3	2.5	68.0
199.0	2.0	2.1	1.3	1.9	2.7	2.0	68.0
213.0	2.4	2.6	2.1	1.7	2.4	2.3	68.0
224.0	2.6	1.9	2.0	1.5	2.1	2.0	68.0
230.0	3.2	2.2	1.5	2.0	2.4	2.2	68.0
236.0	1.7	2.5	2.7	1.9	2.3	2.2	68.0
240.0	1.6	2.4	1.9	2.8	2.5	2.2	68.0
254.0	2.1	1.4	1.5	1.9	1.9	1.8	68.0
263.0	1.9	2.1	1.9	2.1	1.7	1.9	68.0
282.0	2.1	2.4	2.0	1.8	2.2	2.1	68.0
293.0	1.5	2.0	1.9	2.0	2.3	1.9	68.0
305.0	2.3	2.2	1.4	2.3	1.9	2.0	68.0
312.0	1.8	2.0	1.9	2.0	1.9	1.9	68.0
321.0	2.5	1.4	2.6	3.3	3.3	2.6	72.5
339.0	1.8	0.8	0	2.6	1.0	1.2	74.5
350.0	2.0	1.8	2.4	1.7	1.8	2.0	78.4
362.0	2.0	1.8	1.5	2.0	1.4	1.7	83.5
371.0	2.0	1.9	2.4	1.6	1.1	1.8	83.9
383.0	1.3	1.5	1.3	1.4	1.0	1.5	91.5
397.0	1.5	1.8	1.4	2.0	1.7	1.7	99.9
403.0	1.6	1.6	2.2	1.8	1.6	1.7	125.8

MOTOR ACTION TIME = 125.8 SECONDS

A " (" INDICATES THE PRECEDING MDD HAS EXCEEDED THE M + 3 SIGMA DESIGN CRITERIA

Table 20

RSRM-21B FORWARD SEGMENT NON-STAR TIP INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTOR (CSF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE	REQUIRED S.F.
3.5	25.54	58.89	37.86	55.79	36.55	25.54	74.0	2.0
13.0	+	8.55	9.29	8.90	5.56	5.56	336.0	1.5
27.0	+	+	+	+	+	+	74.0	1.5
44.0	+	+	+	+	+	+	74.0	1.5
60.0	+	+	+	+	+	+	74.0	1.5
94.7	+	+	+	+	+	+	74.0	1.5
142.0	+	+	+	+	+	+	74.0	1.5
152.0	16.68	+	+	+	+	16.68	74.0	1.5
162.0	5.95	4.34	14.78	5.88	7.20	4.34	140.0	2.0
175.5	2.68	4.72	4.38	3.73	4.51	2.68	74.0	1.5
187.0	3.61	3.58	3.83	3.62	4.10	3.58	140.0	1.5
199.0	4.99	4.71	7.51	5.21	3.75	3.75	336.0	1.5
213.0	4.13	3.80	4.67	5.84	4.10	3.80	140.0	1.5
224.0	3.89	5.25	4.91	6.51	4.77	3.89	74.0	1.5
230.0	3.13	4.57	6.77	5.09	4.10	3.13	74.0	1.5
236.0	5.07	3.44	3.16	4.45	3.73	3.16	206.0	1.5
240.0	5.13	3.59	4.45	3.04	3.36	3.04	270.0	1.5
254.0	3.97	6.11	5.62	4.30	4.37	3.97	74.0	1.5
263.0	4.40	3.89	4.51	4.00	4.85	3.89	140.0	1.5
282.0	3.97	3.51	4.18	4.69	3.74	3.51	140.0	1.5
293.0	5.52	3.96	4.27	4.07	3.43	3.43	336.0	1.5
305.0	3.39	3.55	5.47	3.43	4.13	3.39	74.0	1.5
312.0	4.47	3.95	4.13	4.04	4.29	3.95	140.0	1.5
321.0	5.07	9.00	4.83	3.84	3.89	3.84	270.0	2.0
339.0	4.02	9.84	+	2.83	7.35	2.83	270.0	1.5
350.0	3.27	3.66	2.72	3.96	3.76	2.72	206.0	1.5
362.0	3.06	3.49	4.16	3.08	4.56	3.06	74.0	1.5
371.0	3.13	3.27	2.55	3.82	5.53	2.55	206.0	1.5
383.0	4.29	3.84	4.15	3.93	3.10	3.10	336.0	1.5
397.0	3.29	2.79	3.52	2.54	3.05	2.54	270.0	1.5
403.0	4.85	4.66	3.49	4.30	4.70	3.49	206.0	1.5

SEGMENT MINIMUM = 2.54 AT THE 397.0 INCH STATION
A " + " MEANS NEGLIGIBLE MDD HAS OCCURRED

ACTUAL SAFETY FACTOR (ASF)

STATION (IN)	DEGREE LOCATIONS 74.0	140.0	206.0	270.0	336.0	MIN.	PLANE
3.5	30.54	70.00	45.16	65.37	45.16	30.54	74.0
13.0	+	13.01	12.81	12.97	8.25	8.25	336.0
27.0	+	+	+	+	+	+	74.0
44.0	+	+	+	+	+	+	74.0
60.0	+	+	+	+	+	+	74.0
94.7	+	+	+	+	+	+	74.0
142.0	+	+	+	+	+	+	74.0
152.0	19.58	+	+	+	+	19.58	74.0
162.0	8.29	6.43	20.16	8.31	9.76	6.43	140.0
175.5	3.39	5.59	5.34	4.56	5.21	3.39	74.0
187.0	4.03	3.89	3.95	3.82	4.22	3.82	270.0
199.0	5.47	5.07	7.90	5.55	4.23	4.23	336.0
213.0	4.57	4.39	5.16	6.40	4.48	4.39	140.0
224.0	4.68	6.21	5.70	7.60	5.47	4.68	74.0
230.0	3.60	5.39	7.23	5.54	4.49	3.60	74.0
236.0	5.97	4.17	3.75	5.12	4.39	3.75	206.0
240.0	5.98	4.38	5.89	3.65	4.05	3.65	270.0
254.0	4.39	6.85	5.65	4.53	4.55	4.39	74.0
263.0	4.75	4.03	4.54	4.23	4.95	4.03	140.0
282.0	4.78	4.19	4.93	5.26	4.40	4.19	140.0
293.0	6.86	4.59	4.87	4.75	4.10	4.10	336.0
305.0	4.35	4.40	6.68	4.37	5.28	4.35	74.0
312.0	5.74	5.18	5.33	5.23	5.46	5.18	140.0
321.0	5.76	10.46	5.58	4.56	4.59	4.56	270.0
339.0	4.47	10.45	+	3.37	8.04	3.37	270.0
350.0	3.66	4.20	3.33	4.58	4.22	3.33	206.0
362.0	3.54	3.96	4.53	3.72	5.19	3.54	74.0
371.0	3.67	3.67	3.21	4.47	6.20	3.21	206.0
383.0	4.87	4.32	4.68	4.42	3.58	3.58	336.0
397.0	3.73	3.26	4.06	3.16	3.68	3.16	270.0
403.0	5.69	5.46	4.28	5.04	5.58	4.28	206.0

SEGMENT MINIMUM = 3.16 AT THE 397.0 INCH STATION

Table 21

RSRM-21A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

CHAMBER PART NO. 1U75162-01
CHAMBER SERIAL NO. 0000063
ADAPTER PART NO. 1U50150-16
ADAPTER SERIAL NO. 0000049

PREFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0	1.031	1.052	1.045	1.128	1.054	1.056	1.022	1.067	1.053	1.022
2.0	1.009	1.027	1.025	1.004	1.002	1.017	1.014	0.992	1.012	0.992
3.0	1.033	1.023	1.015	1.006	1.015	1.011	1.007	0.998	1.013	0.998
4.0	1.027	1.077	1.046	1.053	1.109	1.065	1.061	1.049	1.057	1.027
5.0	0.405	0.396	0.363	0.400	0.385	0.383	0.396	0.369	0.391	0.363
6.0	0.484	0.519	0.522	0.529	0.516	0.485	0.479	0.481	0.501	0.479
7.0	0.639	0.682	0.689	0.684	0.679	0.645	0.668	0.645	0.674	0.639
8.0	0.533	0.562	0.543	0.559	0.558	0.546	0.541	0.528	0.544	0.528
9.0	0.409	0.425	0.418	0.431	0.421	0.407	0.416	0.415	0.417	0.407
10.0	0.376	0.403	0.393	0.399	0.380	0.383	0.376	0.373	0.382	0.373
11.0	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660

CHAMBER PART NO. 1U75163-01(907)
CHAMBER SERIAL NO. 0000024
ADAPTER PART NO. 1U50278-12(909)
ADAPTER SERIAL NO. 0000001

POSTFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0	0.904	0.874	0.876	0.974	0.841	0.883	0.842	0.931	0.880	0.841
2.0	0.826	0.781	0.821	0.751	0.780	0.768	0.737	0.722	0.774	0.722
3.0	0.733	0.716	0.733	0.678	0.703	0.694	0.707	0.675	0.705	0.675
4.0	0.762	0.796	0.789	0.745	0.788	0.792	0.798	0.779	0.789	0.745
5.0	0.181	0.213	0.177	0.134	0.142	0.119	0.106	0.104	0.138	0.104
6.0	0.505	0.543	0.541	0.548	0.514	0.489	0.485	0.475	0.510	0.475
7.0	0.646	0.668	0.644	0.668	0.654	0.613	0.595	0.617	0.645	0.595
8.0	0.543	0.567	0.534	0.526	0.566	0.532	0.517	0.540	0.537	0.517
9.0	0.369	0.407	0.392	0.410	0.402	0.383	0.358	0.402	0.397	0.358
10.0	0.337	0.334	0.338	0.356	0.328	0.343	0.300	0.325	0.336	0.300
11.0	0.568	0.567	0.567	0.557	0.548	0.543	0.557	0.570	0.562	0.543

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Table 21

RSRM-21A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0	0.127	0.178	0.169	0.154	0.213	0.173	0.180	0.136	0.171	0.213
2.0	0.183	0.246	0.204	0.253	0.222	0.249	0.277	0.270	0.247	0.277
3.0	0.300	0.307	0.282	0.328	0.312	0.317	0.300	0.323	0.309	0.328
4.0	0.265	0.281	0.257	0.308	0.321	0.273	0.263	0.270	0.272	0.321
5.0	0.224	0.183	0.186	0.266	0.243	0.264	0.290	0.265	0.253	0.290
6.0	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.006	0.000	0.006
7.0	0.000	0.014	0.045	0.016	0.025	0.032	0.073	0.028	0.027	0.073
8.0	0.000	0.000	0.009	0.033	0.000	0.014	0.024	0.000	0.005	0.033
9.0	0.040	0.018	0.026	0.021	0.019	0.024	0.058	0.013	0.023	0.058
10.0	0.039	0.069	0.055	0.043	0.052	0.040	0.076	0.048	0.050	0.076
11.0	0.092	0.093	0.093	0.103	0.112	0.117	0.103	0.090	0.098	0.117

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0	1.0	1.4	1.4	1.2	1.7	1.4	1.4	1.1	1.3
2.0	1.5	2.0	1.6	2.0	1.8	2.0	2.2	2.2	1.9
3.0	2.4	2.5	2.3	2.6	2.5	2.5	2.4	2.6	2.5
4.0	2.1	2.2	2.1	2.5	2.6	2.2	2.1	2.2	2.2
5.0	1.8	1.5	1.5	2.1	1.9	2.1	2.3	2.1	1.9
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0	0.0	0.1	0.4	0.1	0.2	0.3	0.6	0.2	0.2
8.0	0.0	0.0	0.1	0.3	0.0	0.1	0.2	0.0	0.1
9.0	0.3	0.1	0.2	0.2	0.2	0.2	0.5	0.1	0.2
10.0	0.3	0.6	0.4	0.3	0.4	0.3	0.6	0.4	0.4
11.0	0.7	0.7	0.7	0.8	0.9	0.9	0.8	0.7	0.8

MOTOR ACTION (EXPOSURE) TIME = 124.90 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

Table 21

RSRM-21A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTORS (CSF)

STATION	DEGREE LOCATION									
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0	7.23	5.16	5.43	5.96	4.31	5.31	5.10	6.75	4.31	180.0
2.0	5.02	3.73	4.50	3.63	4.14	3.69	3.31	3.40	3.31	270.0
3.0	3.06	2.99	3.26	2.80	2.94	2.90	3.06	2.84	2.80	150.0
4.0	3.46	3.27	3.57	2.98	2.86	3.36	3.49	3.40	2.86	180.0
5.0	1.54	1.89	1.86	1.30	1.42	1.31	1.19	1.31	1.19	270.0
6.0	+	+	+	+	99.00	+	+	71.67	71.67	330.0
7.0	+	44.93	13.98	39.31	25.16	19.66	8.62	22.46	8.62	270.0
8.0	+	+	56.67	15.45	+	36.43	21.25	+	15.45	150.0
9.0	9.77	21.72	15.04	18.62	20.58	16.29	6.74	30.08	6.74	270.0
10.0	9.33	5.28	6.62	8.47	7.00	9.10	4.79	7.58	4.79	270.0
11.0	5.91	5.85	5.85	5.28	4.86	4.65	5.28	6.04	4.65	240.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

ACTUAL SAFETY FACTORS (ASF)

STATION	DEGREE LOCATION									
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0	8.12	5.91	6.18	7.32	4.95	6.10	5.68	7.85	4.95	180.0
2.0	5.51	4.17	5.02	3.97	4.51	4.08	3.66	3.67	3.66	270.0
3.0	3.44	3.33	3.60	3.07	3.25	3.19	3.36	3.09	3.07	150.0
4.0	3.88	3.83	4.07	3.42	3.45	3.90	4.03	3.89	3.42	150.0
5.0	1.81	2.16	1.95	1.50	1.58	1.45	1.37	1.39	1.37	270.0
6.0	+	+	+	+	99.00	+	+	80.17	80.17	330.0
7.0	+	48.71	15.31	42.75	27.16	20.16	9.15	23.04	9.15	270.0
8.0	+	+	60.33	16.94	+	39.00	22.54	+	16.94	150.0
9.0	10.22	23.61	16.08	20.52	22.16	16.96	7.17	31.92	7.17	270.0
10.0	9.64	5.84	7.15	9.28	7.31	9.58	4.95	7.77	4.95	270.0
11.0	7.17	7.10	7.10	6.41	5.89	5.64	6.41	7.33	5.64	240.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

Table 22

RSRM-21B IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

CHAMBER PART NO. 1U75162-01
CHAMBER SERIAL NO. 0000064
ADAPTER PART NO. 1U50150-16
ADAPTER SERIAL NO. 0000050

PREFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0	1.093	1.069	1.067	1.076	1.056	1.104	1.039	1.068	1.069	1.039
2.0	1.025	1.026	1.017	1.015	1.025	1.007	1.024	1.010	1.021	1.007
3.0	1.038	1.020	1.001	1.008	1.002	1.002	1.007	1.010	1.008	1.001
4.0	1.054	1.071	1.070	1.056	1.072	1.068	1.076	1.073	1.071	1.054
5.0	0.400	0.371	0.438	0.396	0.393	0.388	0.397	0.388	0.395	0.371
6.0	0.515	0.510	0.499	0.478	0.472	0.456	0.451	0.485	0.481	0.451
7.0	0.675	0.706	0.683	0.667	0.670	0.646	0.640	0.670	0.670	0.640
8.0	0.541	0.550	0.557	0.540	0.542	0.538	0.534	0.549	0.542	0.534
9.0	0.423	0.432	0.424	0.428	0.417	0.428	0.435	0.426	0.427	0.417
10.0	0.387	0.382	0.389	0.386	0.397	0.402	0.403	0.390	0.389	0.382
11.0	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660	0.660

CHAMBER PART NO. 1U75163-01(907)
CHAMBER SERIAL NO. 0000025
ADAPTER PART NO. 1U50278-12(909)
ADAPTER SERIAL NO. 0000002

POSTFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0	0.923	0.926	0.898	0.922	0.931	0.941	0.864	0.881	0.923	0.864
2.0	0.726	0.774	0.781	0.781	0.771	0.822	0.721	0.753	0.773	0.721
3.0	0.696	0.724	0.778	0.714	0.781	0.703	0.660	0.692	0.709	0.660
4.0	0.744	0.709	0.740	0.722	0.758	0.736	0.727	0.744	0.738	0.709
5.0	0.088	0.179	0.189	0.182	0.177	0.132	0.118	0.090	0.155	0.088
6.0	0.519	0.551	0.535	0.517	0.489	0.455	0.470	0.501	0.509	0.455
7.0	0.643	0.635	0.631	0.622	0.635	0.629	0.621	0.632	0.632	0.621
8.0	0.500	0.511	0.521	0.504	0.525	0.523	0.490	0.493	0.507	0.490
9.0	0.337	0.369	0.367	0.365	0.347	0.349	0.362	0.390	0.363	0.337
10.0	0.379	0.260	0.291	0.316	0.319	0.310	0.333	0.340	0.318	0.260
11.0	0.536	0.530	0.534	0.532	0.519	0.537	0.539	0.525	0.533	0.519

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Table 22

RSRM-21B IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION	DEGREE LOCATION									
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0	0.170	0.143	0.169	0.154	0.125	0.163	0.175	0.187	0.166	0.187
2.0	0.299	0.252	0.236	0.234	0.254	0.185	0.303	0.257	0.253	0.303
3.0	0.342	0.296	0.223	0.294	0.221	0.299	0.347	0.318	0.297	0.347
4.0	0.310	0.362	0.330	0.334	0.314	0.332	0.349	0.329	0.331	0.362
5.0	0.312	0.192	0.249	0.214	0.216	0.256	0.279	0.298	0.252	0.312
6.0	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001
7.0	0.032	0.071	0.052	0.045	0.035	0.017	0.019	0.038	0.037	0.071
8.0	0.041	0.039	0.036	0.036	0.017	0.015	0.044	0.056	0.038	0.056
9.0	0.086	0.063	0.057	0.063	0.070	0.079	0.073	0.036	0.067	0.086
10.0	0.008	0.122	0.098	0.070	0.078	0.092	0.070	0.050	0.074	0.122
11.0	0.124	0.130	0.126	0.128	0.141	0.123	0.121	0.135	0.127	0.141

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION	DEGREE LOCATION								
(NO.)	0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0	1.4	1.1	1.3	1.2	1.0	1.3	1.4	1.5	1.3
2.0	2.4	2.0	1.9	1.9	2.0	1.5	2.4	2.0	2.0
3.0	2.7	2.4	1.8	2.3	1.8	2.4	2.8	2.5	2.3
4.0	2.5	2.9	2.6	2.7	2.5	2.6	2.8	2.6	2.6
5.0	2.5	1.5	2.0	1.7	1.7	2.0	2.2	2.4	2.0
6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0	0.3	0.6	0.4	0.4	0.3	0.1	0.2	0.3	0.3
8.0	0.3	0.3	0.3	0.3	0.1	0.1	0.3	0.4	0.3
9.0	0.7	0.5	0.5	0.5	0.6	0.6	0.6	0.3	0.5
10.0	0.1	1.0	0.8	0.6	0.6	0.7	0.6	0.4	0.6
11.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.1	1.0

MOTOR ACTION (EXPOSURE) TIME = 125.80 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

Table 22

RSRM-21B IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTORS (CSF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0	5.40	6.42	5.43	5.96	7.34	5.63	5.25	4.91	4.91	330.0
2.0	3.07	3.64	3.89	3.92	3.61	4.96	3.03	3.57	3.03	270.0
3.0	2.68	3.10	4.12	3.12	4.15	3.07	2.65	2.89	2.65	270.0
4.0	2.96	2.54	2.78	2.75	2.92	2.77	2.63	2.79	2.54	60.0
5.0	1.11	1.80	1.39	1.62	1.60	1.35	1.24	1.16	1.11	0.0
6.0	+	+	+	+	+	99.00	+	+	99.00	240.0
7.0	19.66	8.86	12.10	13.98	17.97	37.00	33.11	16.55	8.86	60.0
8.0	12.44	13.08	14.17	14.17	30.00	34.00	11.59	9.11	9.11	330.0
9.0	4.55	6.21	6.86	6.21	5.59	4.95	5.36	10.86	4.55	0.0
10.0	45.50	2.98	3.71	5.20	4.67	3.96	5.20	7.28	2.98	60.0
11.0	4.39	4.18	4.32	4.25	3.86	4.42	4.50	4.03	3.86	180.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

ACTUAL SAFETY FACTORS (ASF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0	6.43	7.48	6.31	6.99	8.45	6.77	5.94	5.71	5.71	330.0
2.0	3.43	4.07	4.31	4.34	4.04	5.44	3.38	3.93	3.38	270.0
3.0	3.04	3.45	4.49	3.43	4.53	3.35	2.90	3.18	2.90	270.0
4.0	3.40	2.96	3.24	3.16	3.41	3.22	3.08	3.26	2.96	60.0
5.0	1.28	1.93	1.76	1.85	1.82	1.52	1.42	1.30	1.28	0.0
6.0	+	+	+	+	+	99.00	+	+	99.00	240.0
7.0	21.09	9.94	13.13	14.82	19.14	38.00	33.68	17.63	9.94	60.0
8.0	13.20	14.10	15.47	15.00	31.88	35.87	12.14	9.80	9.80	330.0
9.0	4.92	6.86	7.44	6.79	5.96	5.42	5.96	11.83	4.92	0.0
10.0	48.38	3.13	3.97	5.51	5.09	4.37	5.76	7.80	3.13	60.0
11.0	5.32	5.08	5.24	5.16	4.68	5.37	5.45	4.89	4.68	180.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

RSRM-21A Aft Dome Factory Joint Prefire vs. Postflight
Contour Comparison for Asymmetric Erosion Study

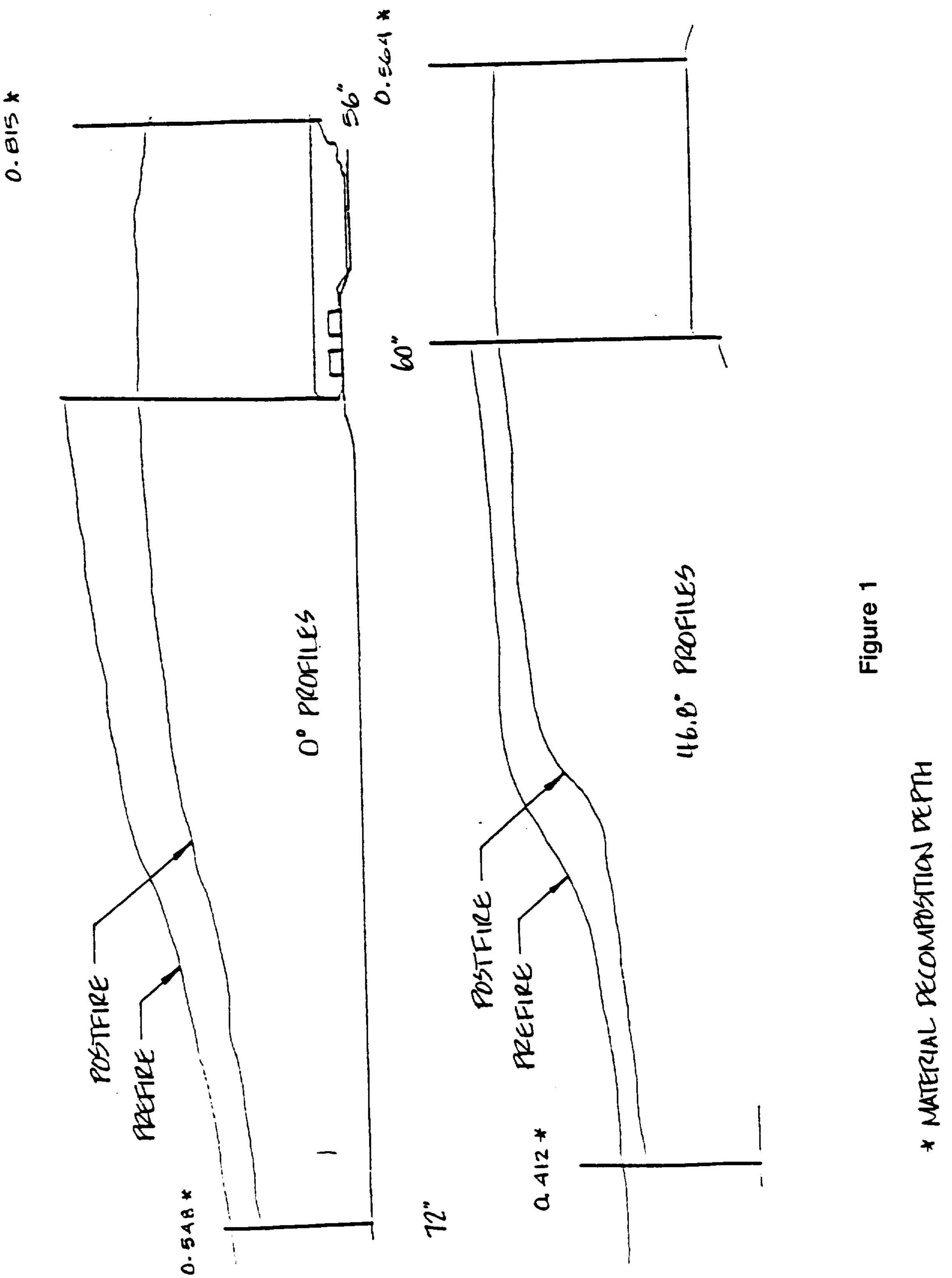


Figure 1

RSRM-21A Aft Dome Factory Joint Prefire vs. Postflight Contour Comparison for Asymmetric Erosion Study

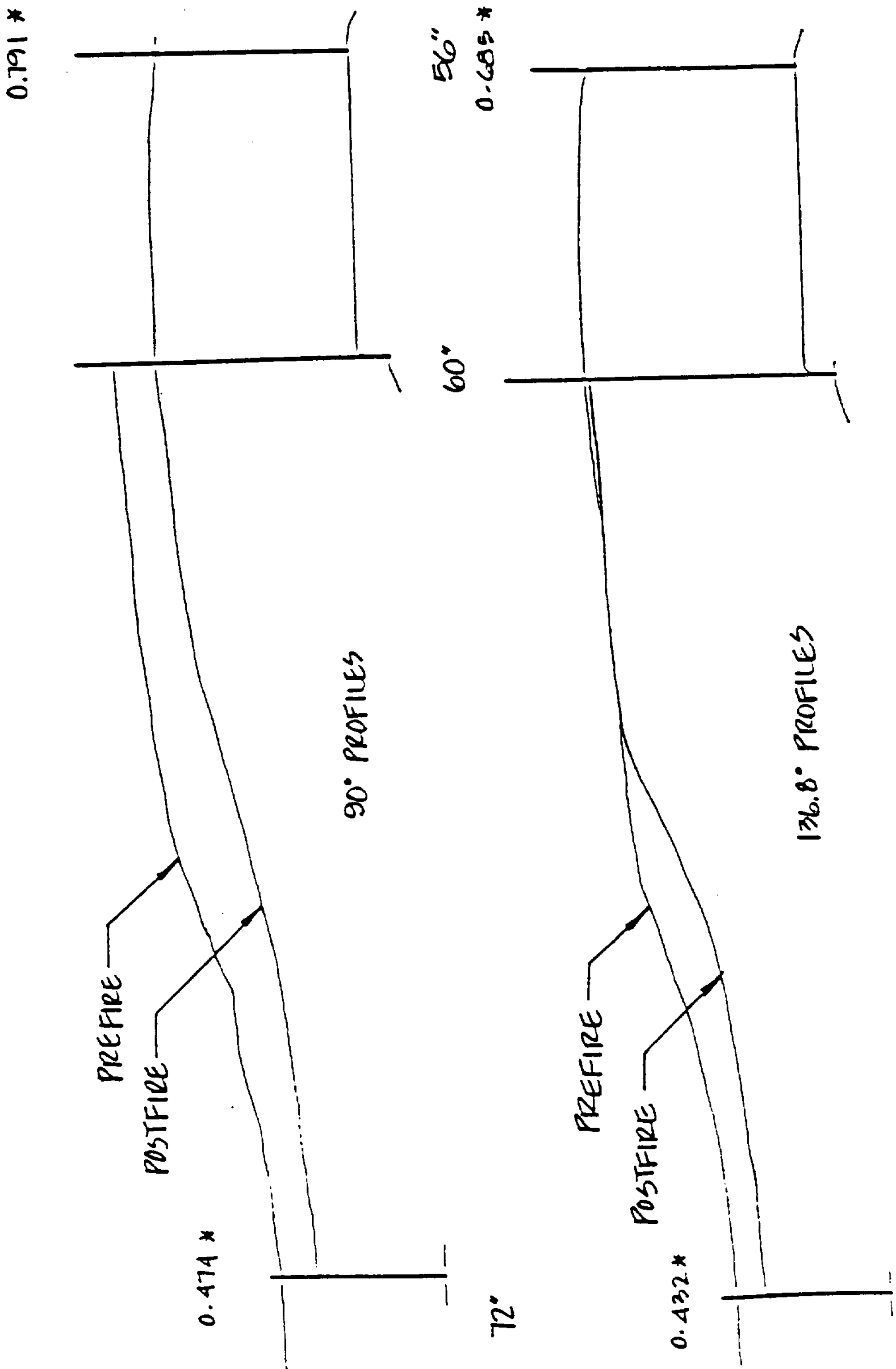
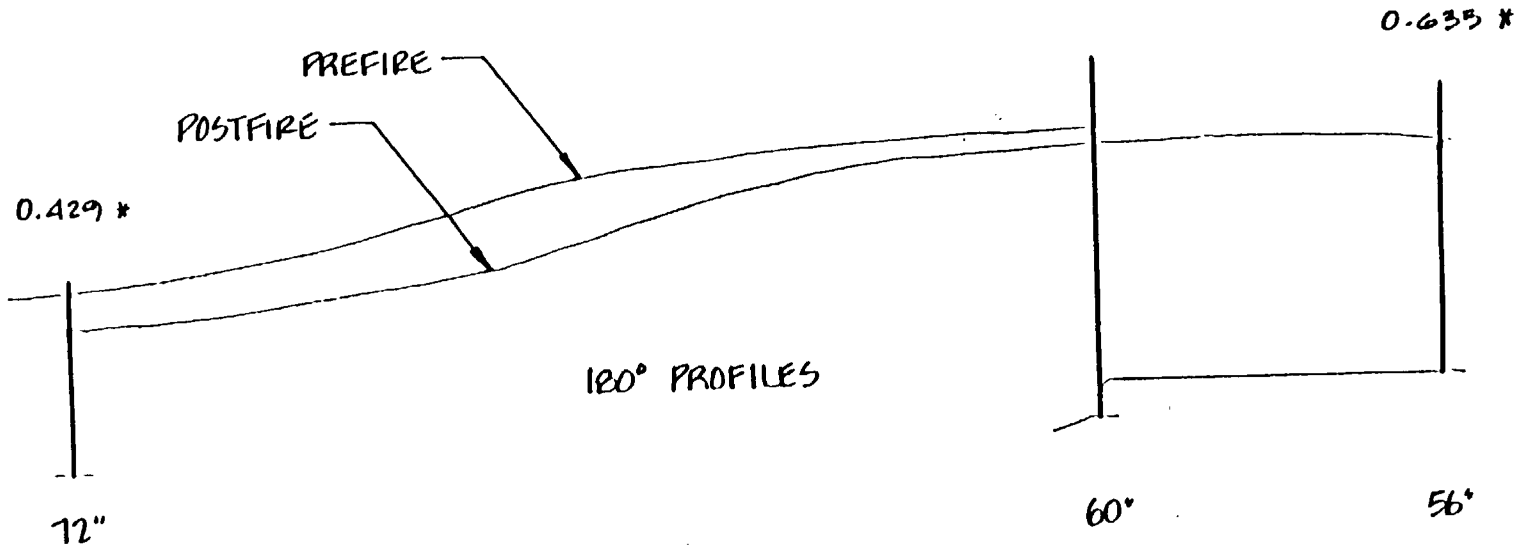


Figure 2

* MATERIAL DECOMPOSITION DEPTH

RSRM-21A Aft Dome Factory Joint Prefire vs. Postflight Contour Comparison for Asymmetric Erosion Study



* MATERIAL DECOMPOSITION DEPTH

Figure 3

RSRM-21A Aft Dome Factory Joint Prefire vs. Postflight Contour Comparison for Asymmetric Erosion Study

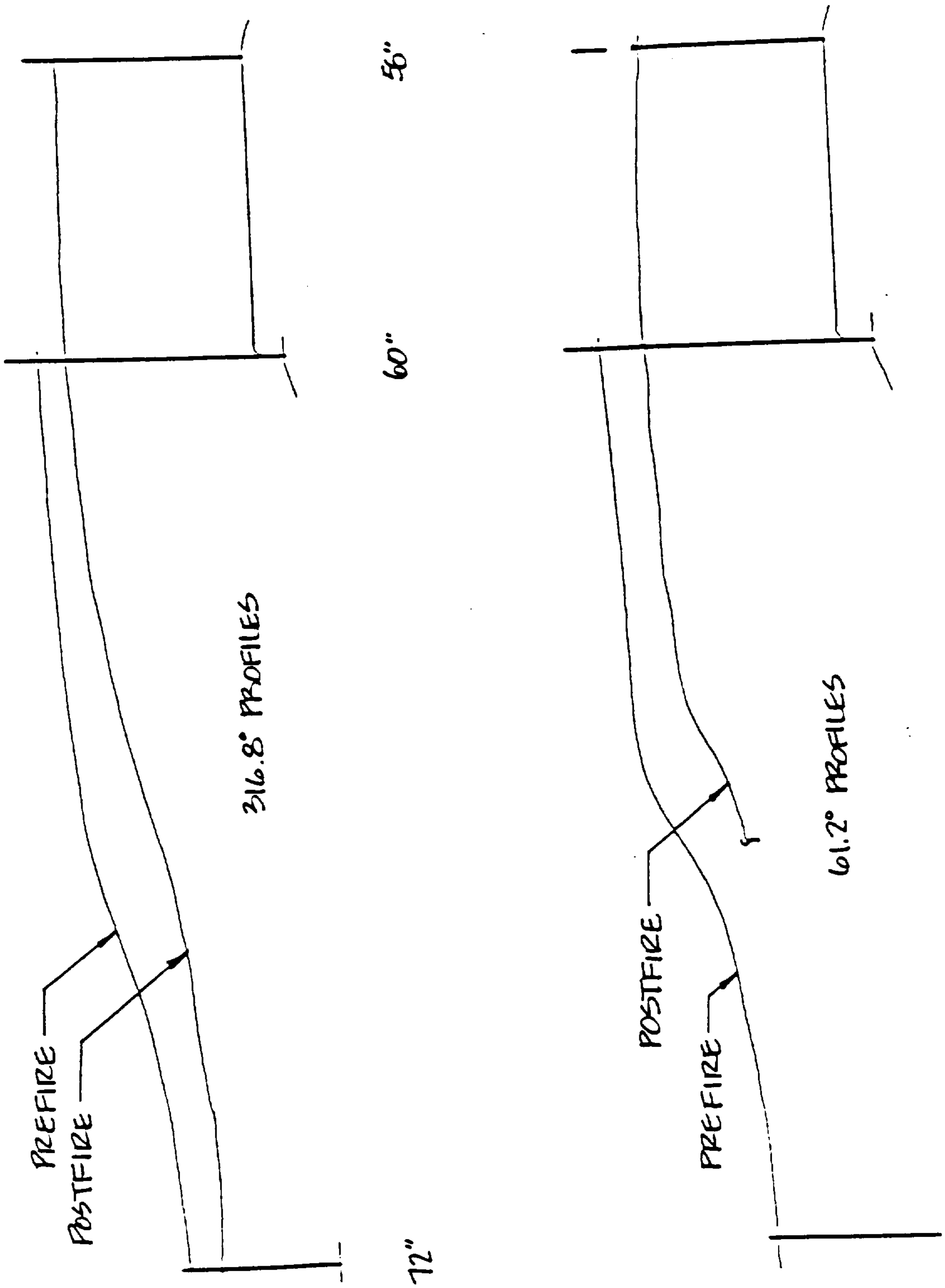


Figure 4

RSRM-21A Aft Dome Factory Joint Prefire vs. Postflight Contour Comparison for Asymmetric Erosion Study

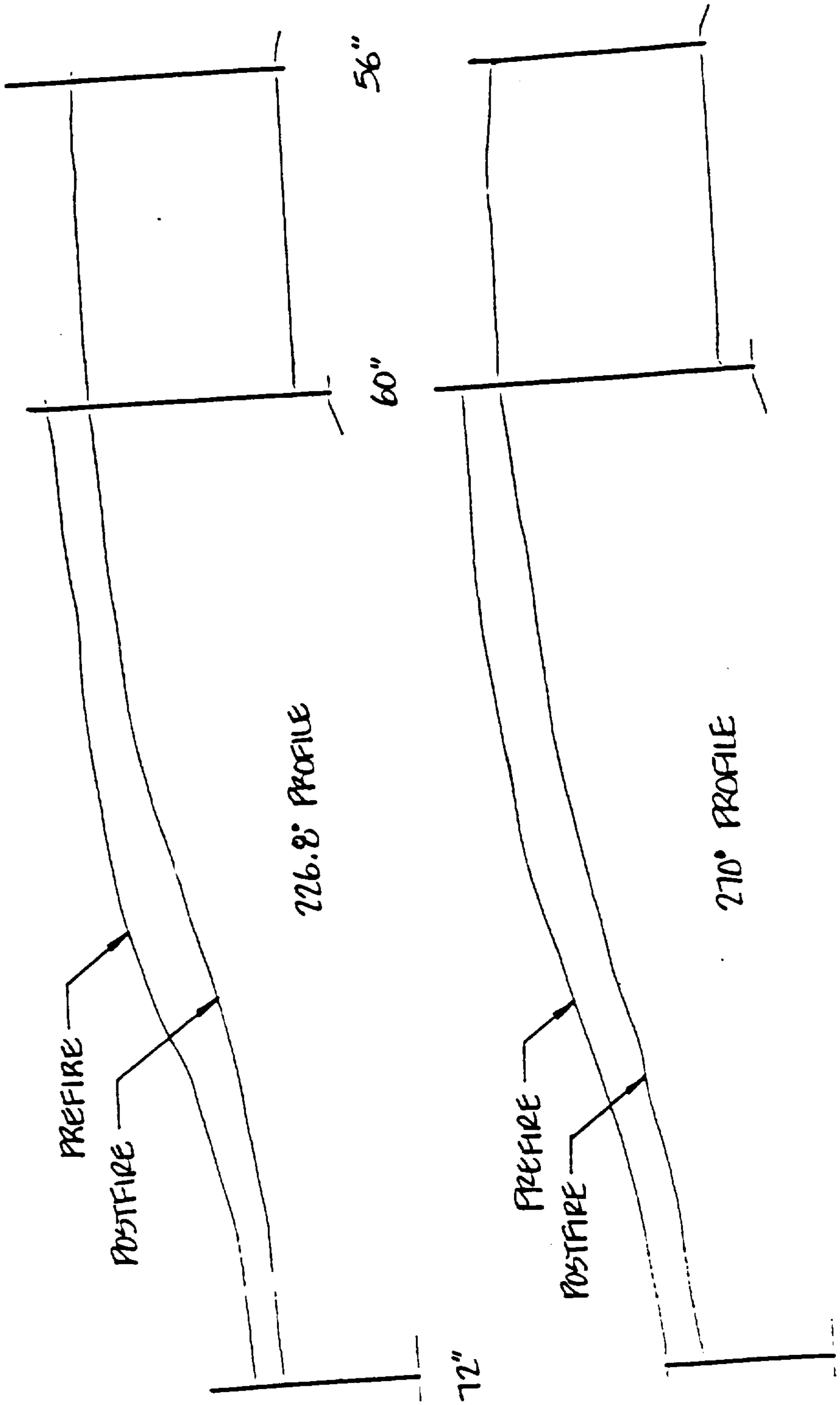


Figure 5